Monday 5 October 2020

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Symposium Program Booklet

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Hussain Bokhari (Founder, Holistic Bodies | International Space University ISP 2020 Team Project) (*Tuesday twilight session*)

Dr Danielle Carroll (TRISH/UC San Francisco Space Health Innovation Fellow) (*Monday morning session 2*)

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Dr Jonathan Clarke (President, Mars Society Australia | UNSW | Centre of Excellence in Astrobiology, Amity University | Swinburne University of Technology) (*Monday afternoon and Tuesday morning sessions*)

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Professor Virginia Kilborn (Dean of Science, Swinburne University of Technology) (*Tuesday afternoon session*)

Rabbi Dr Aviva Kipen (Spiritual Director | Victorian DHHS | NHMRC) (*Tuesday afternoon session 2*)

Dr Astrid-Christina Koch (Directorate-General for Defence Industry and Space, European Commission) (*Tuesday evening session*)

Professor Andy Koronios (CEO, SmartSat CRC) (*Monday morning opening session*)

Dr James Kurrle (*Monday afternoon and twilight sessions*)

Dr Peter Lee (*Monday morning session 2*)

Dr Daniel Liang (CSIRO Manufacturing, High Performance Metal Industries Program**)**
(*Tuesday morning session 2*)

Jonathan Lim (The *Jus Ad Astra* Project | Solicitor, WiseLaw) (*Tuesday morning session 1*)

Associate Professor Rachel Lowe (London School of Hygiene and Tropical Medicine) (*Tuesday evening session*)

Guy Murphy (Director, Mars Society Australia) (*Monday afternoon session*)

Dr Michaela Musilova (Director for HI-SEAS at the International Moonbase Alliance)
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Dr Ali Nasseri (University of British Colombia | International Space University SSP 2014 Team Project)
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Andrew Simon-Butler (The *Jus Ad Astra Project*) (*Tuesday morning session 1*)

Vienna Tran (Medical Student, University of Adelaide | *Symposium Co-Host and online logistics coordinator*)
(*Monday and Tuesday twilight sessions and Tuesday evening session*)

Hardam Tripathi (The *Jus Ad Astra Project* |Trip Law, P.A.) (*Tuesday morning session 1*)

Dr Shane Usher (Research Fellow, Department of Chemical Engineering, University of Melbourne)
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Markus Woltran (Office of the Director of the United Nations Office for Outer Space Affairs (UNOOSA)) (*Tuesday evening session*)

List of Institutions and Affiliations

The *ad astra vita* project
Aerospace Human Factors Association
Aerospace Medical Association
Centre of Excellence in Astrobiology, *Amity University*, India
The Australian Space Agency
Brigham and Women's Hospital, Boston
Brown University
Centre for a Spacefaring Civilization
Department of Art, *Chapman University*
Commonwealth Scientific and Industrial Research organisation (CSIRO)
CSIRO Manufacturing, High Performance Metal Industries Program
Space Science and Technology Centre, *Curtin University*
Delft University of Technology
Dipteron UG
Directorate-General for Defence Industry and Space, *European Commission*
Flinders University
College of the Humanities, Arts and Social Sciences, *Flinders University*
Harvard Medical School
HI-SEAS
Holistic Bodies
InnovaSpace UK
International Moonbase Alliance
International Space University
International Space University SSP 2014 Team Project
International Space University ISP 2020 Team Project
The *Jus Ad Astra* Project
Kings College London
London School of Hygiene and Tropical Medicine
Manchester Metropolitan University
Mars Society Australia
NASA
Educator Professional Development Specialist, *NASA* Langley Research Center
Health and Air Quality Applications, *NASA*
NHMRC
The Open University
RMIT University
SAGA Space Architects
SEADS
SmartSat CRC
Space Surgery Association of the Aerospace Medical Association
Swinburne University of Technology
Trip Law, P.A.
TRISH/University of California San Francisco Space Health Innovation Fellowship
Office of the Director of the *United Nations Office for Outer Space Affairs* (UNOOSA))
United States Air Force
The University of Adelaide
The University of British Colombia
The University of California
The University of Louisville
The University of Luxembourg
The University of Melbourne
Department of Chemical Engineering, *The University of Melbourne*
Department of Medical Education, *The University of Melbourne*
The University of NSW
Victorian DHHS
Wake Forest Institute for Regenerative Medicine
WiseLaw

Special thanks are due to:

The *ad astra vita* project team

The Directors of Mars Society Australia

The members of the *Jus Ad Astra* project

The GEO Health Community of Practice

The Executive Committee of the Space Surgery Association of the Aerospace Medical Association

The Australian Space Agency

The European Commission

The International Space University

NASA

UNOOSA

World Space Week

The University of Melbourne for providing the Zoom facilities

Our back-of-house logistics team, Melanie Ward and Vienna Tran, for helping with the smooth running of the Symposium.

All the guest speakers and session chairs, who generously donated their time and efforts, and to their affiliated institutions and organisations.

Everyone who assisted with publicity

All the registrants

We hope to see you again in 2021!

Speaker Bios (in alphabetical order)

Annalea Beattie (Mars Society Australia | RMIT University | Centre of Excellence in Astrobiology, Amity University, India) (*Monday and Tuesday afternoon sessions*)

Annalea Beattie is an artist whose practice considers how art making in extreme Mars-like environments can enrich thinking about how we might live together in the future off-Earth, in circumstances that are not conducive to but are in fact inhospitable to art. Her work employs participatory methods and collaboration in often harsh, dark and extreme places, in conditions and environments analogous to those on Mars.

Annalea recently completed her doctorate at RMIT University and is Adjunct Professor at the Centre of Excellence in Astrobiology at Amity University, Mumbai. She is a Director of Mars Society Australia and a Director of the National Space Society of Australia. Annalea is a member of the Association of Mars Explorers and has contributed to three Springer volumes on the role of art in future communities off-Earth.

Professor Phil Bland (John Curtin Distinguished Professor and Director of the Space Science and Technology Centre, Curtin University) (*Tuesday afternoon session 1*)

Professor Phil Bland is the Director of the Space Science and Technology Centre (SSTC) at Curtin University. His goal is to inspire the public and advance industry through space mission science and engineering.

Phil Bland joined Curtin as an ARC Laureate Fellow in 2012. Prior to this he was Director of the Impacts and Astromaterials Research Centre at Imperial College London. He graduated in geology from the University of Manchester in 1991. His interest in planetary science began with a three-year post as curator of meteorites at the Open University. He was awarded a PhD in 1995. Phil spent a sent a year as a Royal Society Overseas Research Fellow at the WA Museum before taking up a Particle Physics and Astronomy Research Council Research Fellowship at the Natural History Museum (London). In 2000 he was awarded a Royal Society University Research Fellowship.

Professor Bland came to Curtin from Imperial College London on an ARC Laureate Fellowship in 2012. His research is focused on the origin and evolution of the solar system, and planetary exploration. His team has a unique combination of experience: in space mission and exploration science, blue sky planetary research, and engineering.

With seventeen international partners across 5 continents his team has built a global observational facility to track meteorites transiting our atmosphere and determine where they came from in the solar system. Partnering with Lockheed Martin, they have translated this technology into a wide-field space situational awareness solution. The team is the Australian node for the NASA SSERVI program, formally representing the Australian planetary community to the agency. They have science team membership on seven current missions (across NASA, ESA, JAXA, and CNSA) and 5 previous planetary missions. They have developed deep-space qualified hardware for landers on Mars and Titan. The first SSTC spacecraft will be launched Q2 2021.

Professor Bland believes that research and public engagement are inseparable, and he is proud of his group's achievements in outreach and citizen science. They won the Eureka Prize in 2016 and engage with the media to bring the excitement of space exploration to a wide audience.

(Information from LinkedIn, image from: https://bowraodea.com.au/30146/)

Hussain Bokhari (Founder, Holistic Bodies | International Space University ISP 2020 Team Project) (*Tuesday twilight session*)

Hussain has earned his undergraduate and graduate degrees in the field of Aerospace Engineering from Ryerson University in Toronto. Specializing in CubeSat systems engineering, Hussain has helped launched satellites conducting science experiments and payloads related to materials radiation testing. Hussain is an active member of the Professional Engineers Association and an alumnus of the International Space University Inaugural Interactive Space Program 2020. Hussain believes that a purposeful life requires exploration of oneself. Hussain started an entrepreneurial venture in the health technology industry to help people substitute their bad habits through education and empowerment. Hussain hopes to merge space and health in hopes to improve the future quality of health in human beings.

Dr Danielle Carroll (TRISH/UC San Francisco Space Health Innovation Fellow) (*Monday morning session 2*)

Dani earned her B.A. degree at the University of Virginia, after which she was commissioned as an officer in the U.S. Air Force. She flew high-performance jet aircraft on active duty for several years, later transitioning into the Reserve to attend medical school back at UVa. She is currently a General Surgery resident at UC San Diego, having paused clinical rotations in order to serve as TRISH/UC San Francisco Space Health Innovation Fellow. Alongside her fellowship, Dani serves as an instructor pilot at a local flight school and is currently completing a master's degree in Aerospace Engineering through the CU Boulder Bioastronautics program. In her free time, she enjoys SCUBA diving, climbing, playing soccer, and distance running with her rescue pup, Rosie.

Dr Helena Chapman (Associate Program Manager, Health and Air Quality Applications, NASA) (*Monday morning opening session*)

Helena Chapman serves as Associate Program Manager for Health and Air Quality Applications in the Applied Sciences Program (Booz Allen Hamilton) of the Earth Science Division at NASA Headquarters. In this focus area, her team promotes the use of Earth observation data in public health applications, related to air quality management and infectious disease prevention and control. She is passionate about highlighting the One Health concept, which emphasizes the value of transdisciplinary health collaborations to investigate and mitigate health risks of humans, animals, and ecosystems. She received her doctoral degree in Public Health (One Health) and master's degree in Public Health (Epidemiology) from the University of Florida, and her medical degree from the Iberoamerican University in the Dominican Republic.

Dr Thomas Cheney (The Open University | Executive Director, Centre for a Spacefaring Civilization) (*Monday evening session*)

Dr Thomas Cheney is Lecturer in Space Governance within AstrobiologyOU, at the Open University. He is active in researching space law, policy and governance. His research focuses on planetary protection and environmental aspects of space governance, as well as space resources and property rights. Thomas is also Executive Director of the Centre for a Spacefaring Civilization; a space law and policy think tank.

Dr Rowena Christiansen (University of Melbourne | the *ad astra vita* project | Mars Society Australia) (*Symposium Convenor; Monday morning, Tuesday afternoon and Tuesday evening sessions*)

Dr Rowena Christiansen is passionate about space medicine and taking a holistic approach to health and wellbeing in the space environment. While holding a career goal of becoming one of Australia's first space physicians, she is also a strong proponent of knowledge-sharing, and often engages in public space health outreach activities. Rowena is a medical educator in the University of Melbourne Medical School, and also works as a pre-hospital emergency doctor and life support instructor. She is a Fellow of the Aerospace Medical Association and of Ormond College at the University of Melbourne. Rowena has undertaken post-graduate training in emergency medicine and critical care, women and children's health, aviation medicine and space studies, and disaster health and emergency management, all contributing to her special interests. Her current research projects include space medicine and surgery, COVID-19 and seasonality, and resuscitation science. Rowena is the founder of the *"ad astra vita"* space medicine and life sciences project and space health consultancy, and holds a number of senior voluntary aerospace association positions. She is a strong human rights advocate, particularly regarding both public health and the emerging area of human rights in space.

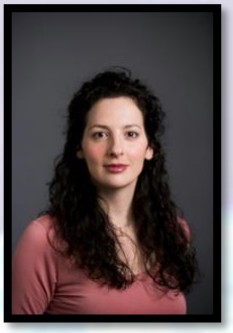
Qualifications: BA Honours, LLB, Graduate Diploma in Education, MBA, MBBS, Australian Certificate of Civil Aviation Medicine, Graduate Diploma in Child Health, Master of Emergency Health, ISU SHSSP16 (Dux), Graduate Certificate in Space Studies.

Konstantin Chterev (Space Psychologist Lead at SAGA Space Architects) (*Monday twilight session*)

Konstantin holds an MSc in Occupational and Organisational Psychology from the University of Surrey, and is an International Space University alumnus, attending the Space Studies Program in 2018. He has assisted on projects for NASA, ESA, and various citizen-science organisations including the Austrian Space Forum and Space Generation Advisory Council.

As a psychologist, his research looks into human performance in extreme environments, specifically assessment, group dynamics, and well-being. Currently, Konstantin is the Space Psychologist Lead at SAGA Space Architects, who are conducting a 3-month lunar analogue mission in Arctic Greenland until December 2020.

Dr Ilaria Cinelli (President, Aerospace Human Factors Association | AsMA Councillor) (*Tuesday twilight session*)



Ilaria Cinelli Eng. PhD FAsMA is a senior engineer with records of accomplishments in biomedical engineering and space exploration. Her work experience is in biomedical engineering, neural engineering, human factors, mission design, analogue missions, space medicine, leadership, coaching and management.

Ilaria has a Bachelor's and Master's degree in Biomedical Engineering from the University of Pisa (Italy), and a structured PhD in Neural Engineering from the National University of Ireland Galway (Republic of Ireland). She is also a graduate of the Space Studies Program run by the International Space University at TU Delft (The Netherlands). More recently, she has completed a Postdoc at Tufts University (USA) in Neuromodulation.

Ilaria is a Fellow of the Aerospace Medical Association, President of the Aerospace Human Factors Association, Member-at-Large of the Aerospace Medical Association Council and Member-at-Large of the Life Sciences and Biomedical Engineering Branch. She is also Co-Leader of the Space Exploration Group of the Space Generation Advisory Council. In addition, Ilaria is an invited member of The Mars Society Steering Committee, thanks to her extensive experience gained in isolation while conducting several analogue missions at the Mars Desert Research Station.

Dr Jonathan Clarke (President, Mars Society Australia | UNSW | Centre of Excellence in Astrobiology, Amity University | Swinburne University of Technology) (*Monday afternoon and Tuesday morning sessions*)

Dr Jonathan Clarke is President of Mars Society Australia and a geologist with more than 40 years professional experience in the industry, government and university sectors. His Mars-related interests are astrobiology, planetary geology, Mars analogues, and surface operations, habitat design, and landing site selection for crewed missions. Jonathan has spent a total of six months in various Mars analogue simulations at MDRS and FMARS, and has taken part in Mars analogue expeditions to Arkaroola, the Pilbara, Ladakh, and New Zealand. He lives in Canberra and is an associate of the Australian Centre for Astrobiology (UNSW)), Adjunct faculty member of Amity Centre of Excellence in Astrobiology (Mumbai), and, is a post-graduate instructor in astrobiology at the Swinburne University Centre for Astrophysics and Supercomputing (Melbourne).

Dr Danyal Fer (University of California | USAF)**:** (*Monday morning session 2*)

Danyal Fer is a general surgery resident at University of California San Francisco East Bay and a Captain in the United States Air Force. He is currently the Surgical Translational Research Lead in Applied Research at Johnson and Johnson Medical Device and visiting scholar at University of California Berkeley Automation Laboratory. His research focuses on transmission of surgical knowledge and action utilizing robotics and artificial intelligence.

Dr Arthur Formanek (Brigham and Women's Hospital, Boston | Harvard Medical School) (*Monday morning session 2*)

Arthur Formanek, MD is an anesthesiologist and intensivist at Brigham and Women's Hospital with the rank of Instructor at Harvard Medical School. He has patented an IV air trap designed to work in microgravity that will allow rapid transfusion in spaceflight and austere environments. Other research interests include regional anesthesia techniques for neurosurgery and risk of urosepsis in spaceflight. Also, he is a co-founder and Secretary of the Space Surgery Association.

Dr Bergita Ganse (Research Fellow, Manchester Metropolitan University) (*Monday twilight and evening sessions*)

Dr Bergita Ganse is an Orthopaedic Surgeon and a Physiologist with a research focus on Space Medicine and the musculoskeletal system in spaceflight. She has received her Dr. med. from Lübeck University and her habilitation (postdoctoral thesis) from RWTH Aachen University in Germany. Bergita is currently a Research Fellow at Manchester Metropolitan University in the UK, funded by the German Research Foundation (DFG). She is a co-investigator of an ISS experiment and involved in large international studies working with the German Aerospace Center (DLR), the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA). More details: www.bergitaganse.de

Associate Professor Alice Gorman (College of the Humanities, Arts and Social Sciences, Flinders University) (*Tuesday afternoon sessions*)

Dr Alice Gorman is an internationally recognised leader in the field of space archaeology and author of the award-winning book book *Dr Space Junk vs the Universe: Archaeology and the Future*. Her research focuses on the archaeology and heritage of space exploration, including space junk, planetary landing sites, off-earth mining, space habitats, rocket launch pads and antennas. She is an Associate Professor at Flinders University in Adelaide and a heritage consultant with over 25 years' experience working with Indigenous communities in Australia. In collaboration with NASA and Chapman University, she is part of a team conducting the first archaeological study of the International Space Station. She is also a mentor in the UN Office of Outer Space Affairs Space4Women Mentor Network and a member of the Advisory Council of the Space Industry Association of Australia. *(Photo credit: Daniel Kukec)*

John Haynes (Program Manager, Health and Air Quality Applications, NASA) (*Monday morning opening session*)

John Haynes serves as Program Manager for Health and Air Quality Applications in the Applied Sciences Program of the Earth Science Division at NASA Headquarters. The Program promotes the use of Earth observations in air quality management and public health, particularly involving environmental health and infectious diseases. He is the Co-Chair of the Group on Earth Observations (GEO) Health Community of Practice and Earth Observations for Health. He also serves as the NASA Program Applications Lead on Tropospheric Emissions: Monitoring Pollution (TEMPO), the Multi-Angle Imager for Aerosols (MAIA), and the Geostationary Carbon Observatory (GeoCarb) satellite missions. He received his MS in Meteorology from the University of Oklahoma and BS in Meteorology from the University of South Alabama.

Dr Gail Iles (Senior Lecturer in Space Physics, RMIT University) (*Tuesday morning and afternoon sessions*)

Gail Iles is a Senior Lecturer in Space Physics at RMIT University researching electromagnetic technologies to shield astronauts against space radiation. Dr Iles tests prototype devices in the lab, on sounding rockets, and in space. Dr Iles has 15 years' experience of working at nuclear facilities and synchrotrons around the world to explore the effects of radiation on materials. From 2007-2012, Dr Iles worked for the European Space Agency as a researcher and astronaut instructor and holds a medal for extensive time spent experimenting in zero gravity. In 2011, she was presented the WISE Champion Award by HRH Princess Anne, for inspiring children, particularly girls, to study STEM subjects. Dr Iles is a Fellow of the Institute of Physics, on the Board of Directors of the Space Industry Association of Australia and is a member of the Space Medicine and Life Sciences Technical Advisory Group to the Australian Space Agency.

Deepika Jeyakodi (The *Jus Ad Astra* Project) (*Workshop Coordinator, Monday evening session*)

Deepika Jeyakodi is a Commercial Contracts officer at an aerospace and defence company in the Netherlands.

She holds an Advanced LL.M. in Air and Space Law from the Leiden University, an LL.M in International Law and Indian Constitutional Law from the Madras University, a diploma in IP laws and a B.A., B.L (Hons) from the TNDALU in Chennai,India, and attended the ISU's SSP in 2018.

She is the co-founder of a human rights-based NGO in India, and practised law at the Madras High Court prior to moving to the Netherlands. She recently co-authored a book on innovation strategy.

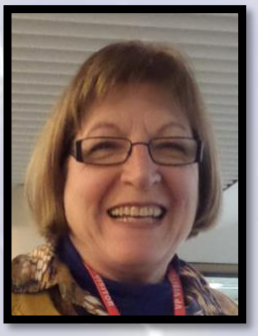
Dr Tovy Kamine (President, Space Surgery Association of the Aerospace Medical Association (AsMA)) (*Session Chair, Monday morning session 2)*

Tovy Kamine is a Trauma, Acute Care, and Critical Care surgeon at Baystate Health in Springfield, MA. He is board certified in General Surgery and Critical Care. He is a civilian pilot and will fly anything he can get his hands on, from Cessnas to Helicopters, to Seaplanes, to a P-51. He is married to Rebecca Barron, MD, and has two young children. In his little remaining free time he volunteers in the Civil Air Patrol where he is a Captain, Transport Mission Pilot, and Squadron Medical Officer.

Professor Virginia Kilborn (Dean of Science, Swinburne University of Technology) (*Tuesday afternoon session 1*)

Professor Virginia Kilborn is Dean of Science at Swinburne University of Technology. Her research focuses on understanding galaxy evolution through studying the neutral hydrogen gas in galaxies using next generation radio telescopes. Virginia has 15 years of experience teaching astronomy - both online via the Swinburne Astronomy online program, and on campus as part of the Bachelor of Science. She is currently developing new education and research opportunities in the area of Space technology at Swinburne. Virginia champions multiple gender equity initiatives, co-leads the Swinburne Women's Academic Network (SWAN), and is a founder of the WATTLE women in leadership program.

Rabbi Dr Aviva Kipen (Spiritual Director, Victorian DHHS, NHMRC) (*Tuesday afternoon session 2*)



Rabbi Dr Aviva Kipen has no scientific space qualifications at all. However, as Australia's first ordained female rabbi, she is not fearful of new frontiers and some might even say that her calling was "out of this world".

As a qualified Spiritual Director, Aviva has a private practice that supports people of all spiritual persuasions as they grapple with the "other worldly", their struggle to situate in the vastness and celebrate it.

Her specialty ministry interest is Human Research Ethics. She has served on institutional committees, and is currently serving at state and federal levels on the Research Ethics Committee of the Victorian Department of Health and Human Services and AHEC, the Australian Health Ethics Committee of NHMRC.

Dr Astrid-Christina Koch (Directorate-General for Defence Industry and Space, European Commission) (*Tuesday evening session*)

Astrid-Christina Koch is a Senior Expert in the Directorate-General for Defence Industry and Space (DEFIS) of the European Commission. She works on the international dimension of the EU Space Programme together with European and International partners. She is the point of contact for the Committee on Earth Observation Satellites (CEOS) and the Group on Earth Observations (GEO) in DG DEFIS and is supporting cooperation on Copernicus worldwide. From 2007 – 2012 she served as science diplomat in the EU Delegation to the United States in Washington DC promoting transatlantic science and space cooperation.

Astrid received a Ph.D. in Natural Science from the Christian – Albrechts University in Kiel/Germany. In her free time she enjoys making chocolates. She can be contacted at Astrid-Christina.Koch@ec.europa.eu

Professor Andy Koronios (CEO, SmartSat CRC) (*Monday morning opening session*)

Professor Andy Koronios is the CEO of the SmartSat CRC, a consortium of industry and research organisations developing game changing satellite technologies to catapult Australia into the global space economy. Previously, Andy held the positions of Dean: Industry and Enterprise, and Head of the School of Information Technology and Mathematical Sciences at UniSA.

Andy is a Professor of Information Systems and holds academic qualifications in electrical engineering, computing, and education, as well as a PhD from the University of Queensland. He has extensive experience in both commercial and academic environments and his research areas include data quality, information management and governance, data analytics and the strategic exploitation of information.

Andy has led the establishment of several research concentrations, labs and research centres. He served as the Research Program Leader for System Integration and Interoperability in the CIEAM CRC. He is internationally known for his work in data quality, has been an adjudicator for the European Corporate Data Quality Awards for several years, and is the Editor-In-Chief of the International Journal of Information Quality.

Andy has worked both as a consultant as well as a professional speaker on IT issues in Australia and South East Asia, and has over twenty five years' experience in the academic environment. He is a Fellow of the Australian Computer Society, a Founding Fellow of the International Institute of Engineering Asset Management and a Distinguished Speaker of the ACM.

Dr James Kurrle (*Monday afternoon and twilight sessions*)

Dr James Kurrle (MBBS, B.Science (physiology and neuroscience), MS (aerospace medicine))

James Kurrle is a medical doctor who works in rural Australia. He studied a masters in aerospace medicine at Wright State University in Ohio. He has been part of a team performing mars simulation exercises at the Mars Desert Research Station in Utah and teaching at University of Colorado, Boulder. He also coordinated nationwide Australian research on including aerospace medicine into formal medical training and how the new space agency could foster space medicine in Australia.

Dr Peter Lee (Assistant Professor of Pathology and Laboratory Medicine, Brown University) (*Monday morning session 2*)

Dr. Lee is an Assistant Professor of Pathology and Laboratory Medicine at Brown University and a cardiothoracic surgeon at Southcoast Health in Massachusetts. He received a BS in neuroscience, PhD in pathobiology, and MD degrees all from Brown University. He received a Master of Science (MS) in Space Studies from the International Space University in France, and a Master of Public Health (MPH) from Harvard University. He completed he surgical training at Tufts University, UCLA, and Stanford University. He is board certified in both general surgery and thoracic surgery and is a Fellow of the American College of Surgeons (FACS), a Fellow of the American College of Cardiology (FACC), and a Fellow of the Aerospace Medical Association (FAsMA).

His research interests span the range of clinic, outcomes, translational, and basic science research. He has his own basic science laboratory focusing on skeletal and cardiac muscle tissue engineering, gene therapy and the use of stem cells. He has an interest in applying tissue-engineering technologies for use in regenerative medicine, as replacement tissue, as a biological pump, and an organ-on-a-chip type in vitro experimental model. He also has an interest in aerospace medical and space life sciences research. He has flown multiple microgravity and spaceflight experiments, including in parabolic zero gravity flights, aboard the space shuttle, and on the International Space Station (ISS). He was recently a PI or Co-I on two ISS experiments looking at the effects of spaceflight on fruit fly hearts and stem cell-derived cardiomyocytes. He is also currently a PI or Co-I on four NASA and NIH space-related grants including a suborbital experiment aboard Blue Origin's New Shepard space vehicle and on the ISS.

Dr. Lee is a recipient of the Young Investigator's Award by the American Society for Gravitational and Space Research (ASGSR) as well as a Faculty Research Fellowship by the American College of Surgeons (ACS). He is an elected Academician of the International Academy of Aviation and Space Medicine (IAASM), and the International Academy of Astronautics, a Governing Board member of the ASGSR, an Executive Council member of AsMA, and an executive committee member of the Life Sciences and Biomedical Engineering Branch (LSBEB) and the Space Surgery Association (SSA). Dr. Lee is also a Lt. Colonel in the U.S. Air National Guard where he serves as a general surgeon and flight surgeon and is the Chief of Clinical Services for the 179th Medical Group and flight surgeon. Dr. Lee is also the co-founder and Chief Medical Officer of the innovative medical device company STARK Industries, LLC. He has also served as the medical officer on a one-month Mars simulation mission in the Canadian Arctic as part of the Flashline Mars Arctic Research Station crew and was recently a finalist for the Canadian astronaut selection campaign.

On a personal note, he is a German-born Korean Canadian American, a 7th degree grandmaster in taekwondo, and advanced scuba diver, and a private pilot. Dr. Lee is also a Grand Cross in the Royal Equestrian and Military Order of Saint Michael of the Wing, a Portuguese Roman Catholic dynastic order. In addition to extensive experience with spaceflight projects, Dr. Lee has been actively involved in outreach education for over twenty years. He has mentored countless students and residents of all ages, and has given outreach presentations to hundreds of elementary school children over the years.

Dr Daniel Liang (CSIRO Manufacturing, High Performance Metal Industries Program) (*Tuesday morning session 2*)

Daniel Liang has been a material scientist and processing engineer since 1993 after finishing a PhD degree at Sheffield University, UK. Since he joined CSIRO in 1995, Daniel has carried out and led a number of R&D projects in the areas of novel material development and non-equilibrium processing, such as solid-state forming metal matrix composites, in-situ transforming functional materials assisted by plasma, rapid solidification to induce nano- and micro-scale microstructures, and the integration of functional and structural properties in a component, structure and subsystem. The outcomes of these R&D are being applied in a range of industries and sectors, including heavy transportation, renewable energy, aero-space, and biomedical devices. Currently, he is a principal Research Scientist a, Senior Project Leader in CSIRO Manufacturing at at Clayton, Victoria, Australia.

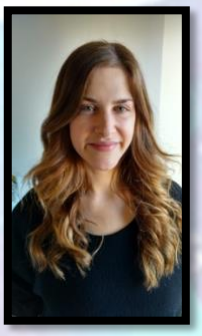
Jonathan Lim (The *Jus Ad Astra* Project | Solicitor, WiseLaw) (*Tuesday morning session*)

Jonathan Lim is an Australian lawyer, geopolitical analyst, and cyber security analyst. He holds a Juris Doctor and Bachelor of Arts from Monash University, and works as a Solicitor at WiseLaw. His specialization spans cyberwarfare, cyber security, Chinese foreign policy, Australian foreign policy, and international space law.

He has worked with the Australia Korea Business Council, Horizon Intelligence, and at the National Information Society Agency – advancing Australia's interests within the Australia-Korea bilateral relationship, monitoring and reporting on the state of economic and political developments across East Asia, and advising on South Korea's engagement with China in the context of the 4IR and ICT affairs.

He is a Young Leader Fellow with Pacific Forum CSIS, prior East Asia Fellow with Young Australians in International Affairs, and is the Special Advisor to the SGAC Space & Cybersecurity Project Group. As a space lawyer he has contributed his perspectives on space legal and policy affairs with the Australian Institute of International Affairs, Room - The Space Journal, and to the Australian government under Australia's 2020 Cyber Security Strategy.

Associate Professor Rachel Lowe (London School of Hygiene & Tropical Medicine) (*Tuesday evening session*)



Rachel Lowe is an Associate Professor and Royal Society Dorothy Hodgkin Fellow at the London School of Hygiene & Tropical Medicine, researching the impacts of global environmental change on infectious disease risk. She leads a group of statisticians, epidemiologists and ecologists working between the Centre on Climate Change & Planetary Health and the Centre for Mathematical Modelling of Infectious Diseases.

She obtained a PhD in Mathematics from the University of Exeter, UK. Her thesis concerned spatio-temporal modelling of climate-sensitive disease risk, with a focus on early warning systems for dengue in Brazil. She held postdoctoral positions at the International Centre for Theoretical Physics in Trieste, Italy, and the Catalan Institute for Climate Sciences (IC3) in Barcelona, Spain, working at the interface of climate prediction science and public health decision-making. Rachel is a member of the World Meteorological Organization COVID-19 Research Task Team.

Guy Murphy (Director, Mars Society Australia) (*Monday afternoon session*)

Guy Murphy's long-standing interest in Mars was initially fired by reading science fiction, and the Mars Pathfinder landing in 1998. He was a co-founder of the Mars Society Australia in 1998. He has participated in scientific expeditions to Mars-like environments in outback South Australia and spoken at Mars conferences in Australia, Europe and North America. A graduate of the University of Melbourne, he is a researcher writer and historian based in Melbourne. His interests in Australian history and Mars share the themes of frontier exploration and human settlement. Guy has also coauthored a number of papers examining the heritage management of space artefacts. He is the author of Mars: A Survival Guide, published by Harper Collins Australia (2010).

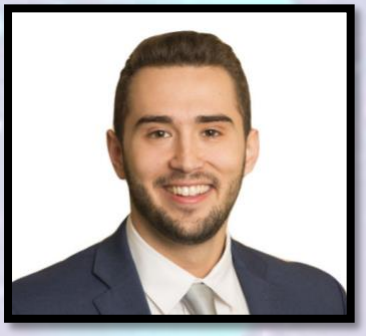
Dr Michaela Musilova (Director for HI-SEAS at the International Moonbase Alliance) (*Monday afternoon session*)

Dr. Michaela Musilova is an astrobiologist with a focus on life in extreme environments. She has a PhD degree from the University of Bristol (UK). Michaela studied and conducted research at University College London (UK), California Institute of Technology (USA), Chiba University (Japan) and others. She is also a graduate from the International Space University (ISU)'s Space Studies Program. Michaela's space research experience includes working at the NASA Jet Propulsion Laboratory; University of London Observatory; Canada-France-Hawaii Telescope; on NASA's and UK Space Agency's MoonLite project; being an analogue astronaut and Commander of numerous simulated missions to the Moon and Mars at the HISEAS station in Hawai'i, and at the Mars Desert Research Station (MDRS) in Utah. Michaela is currently the Director of HI-SEAS, as part of the International MoonBase Alliance. She is also a visiting professor at the Slovak University of Technology, vice-chair of the Slovak Organisation for Space Activities (SOSA), Adjunct Faculty at ISU, visiting researcher at the University of Hawai'i and a senior research adviser for Mission Control Space Services Inc. She has received numerous prizes and grants, including the Emerging Space Leaders Grant from the International Astronautical Federation (2016); Women in Aerospace – Europe Young Professional Award (2016) and she was selected as one of the most promising 30 under 30 by Forbes Slovakia (2015).

Dr Ali Nasseri (University of British Colombia | International Space University SSP 2014 Team Project) (*Tuesday twilight session*)

Ali is an Executive Research Coordinator at the University of British Columbia, managing the Programming Languages at Artificial Intelligence (PLAI) group at UBC. He is also a graduate of the International Space University's Space Studies Program 2014, the results of which he will be sharing with us today.

Theodore Nastase (The *Jus Ad Astra* Project) (*Tuesday morning session 1*)



Theo is a Law graduate from The George Washington University Law School, and William Cranch Fellow at the Office of DC Council member Robert White. He is a New York native, having grown up in NYC before moving to Philadelphia and Washington DC for college and law school.

Theo is a passionate advocate for criminal justice reform in the United States. As a space enthusiast, Theo believes deeply in the sanctity of life and humanity, and seeks to explore how these values and principles may be recognized and protected across the final frontier.

Naomi Norris (Lecturer, Department of Medical Education, University of Melbourne) (*Tuesday afternoon session 1*)

Naomi Norris qualified with a Bachelor of Applied Science in Physiotherapy last century. She has worked across the acute, subacute and community health sectors here in Australia and overseas. Over this time, she has developed a deep interest in the place of stories, context, systems and culture in the care of patients and in the work of inter-professional teams in delivering that care.

This century, Naomi pursued further study in Clinical Research and in Public Health, while continuing to build a career in chronic disease management through developing new inter-sectorial multidisciplinary programs to meet the needs of those with complex chronic health issues to help prevent hospital admission. Looking for a new challenge and fuelled by a desire to contribute to the Health Professions further, Naomi accepted Tutor positions at the University of Melbourne within each of the schools of Physiotherapy, Nursing and Medicine. Then in 2019 she made the move from mixed clinical practice and teaching into predominantly academia and teaching within the Department of Medical Education at the University of Melbourne.

She has brought a collaborative and consultative approach to her work which has focused on the curriculum design, development and implementation of a new stream of learning for first year medical students called "Professional Practice". Naomi is a passionate educator and a lead facilitator of Interprofessional Education and Practice within the Department who values multiple perspectives in developing curriculum for students to enable our future health clinicians to work humbly with empathy and endless curiosity with and for their patients and the health of all society.

Dr Siddharth Pandey (Head of the Centre of Excellence in Astrobiology, Amity University, India | Mars Society Australia) (*Monday and Tuesday afternoon sessions*)

Siddharth is the Head of the Centre of Excellence in Astrobiology at Amity University India. As a part of this, he is leading an initiative to establish India's first dedicated Centre for Astrobiology and Space Biology research in the country. Siddharth is a space engineer with project management and leadership experience working in teams of astrobiologists. Prior to this, he has experience in building sample collection instruments for Mars and Venus surface missions while working at NASA Ames, USA. He has been engaged in education and public outreach activities and is motivated to use space as a tool to spread awareness, social consciousness, and inclusiveness within our communities. He holds PhD degree in Aerospace Engineering from UNSW Canberra, Australia; MS in Space Systems Engineering from TU Delft, Netherlands, and BTech in Aerospace Engineering from Amity University, India.

Professor George Pantalos (Professor of Cardiovascular and Thoracic Surgery and Biomedical Engineering at the University of Louisville) (*Monday morning session 2*)

George Pantalos has been a Professor of Cardiovascular and Thoracic Surgery and Biomedical Engineering at the University of Louisville, in partnership with Jewish Hospital and Norton Children's Hospital, since 2000, after holding similar appointments at the University of Utah. His efforts to investigate cardiovascular function have focused on understanding and treating heart failure with mechanical devices including artificial hearts, ventricular assist devices, and cardiopulmonary support systems.

George has also collaborated with NASA for many years helping to understand cardiovascular adaptation to the weightlessness of space flight and the return to Earth. He has flown 45 research missions on the NASA parabolic flight aircraft and led the development of a cardiovascular diastolic function experiment that flew twice on the Space Shuttle Discovery. Other reduced gravity research projects have included delivery of effective chest compressions for CPR in zero-G, organ perfusion in zero-G, and the development of surgical capabilities for exploration space missions.

Professor Christopher Porada (Wake Forest Institute for Regenerative Medicine) (*Tuesday morning session 2*)

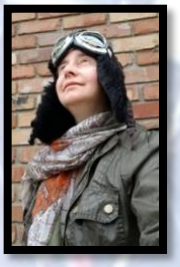
I received a bachelor's degree from Colgate University in molecular biology and a Ph.D. from the University of Nevada, Reno in Molecular and Cellular Pharmacology and Physiology, performing my thesis work on in utero gene therapy under the tutelage of Dr. Esmail Zanjani, a pioneer and world leader in the field of fetal therapies. I am currently a Professor at the Wake Forest Institute for Regenerative Medicine.

My research focus over the last 25 years has been to develop safer and more efficient means of accomplishing gene transfer into clinically relevant cell types in vivo and achieving immunological tolerance to the therapeutic transgene. The ultimate goal is to use this knowledge to develop safe, effective treatments for monogenic diseases such as hemophilia, which could be administered shortly after, or prior to, birth.

In addition to my studies on direct *in vivo* gene delivery, I have spent over 10 years studying stem cell-based gene therapy, employing hematopoietic stem cells and mesenchymal stem cells as delivery vehicles for a variety of marker and therapeutic transgene cassettes, and have a great deal of experience transducing bone marrow-derived stem cells with a variety of viral vectors, and with tracking/characterizing stem cell engraftment after transplantation.

For the last 7 years, as a NASA- and NASA's Translational Research Institute for Space Health (TRISH)-funded investigator, I have been applying my knowledge of hematopoiesis and stem cell assay systems to define the effects of solar particle event and galactic cosmic ray radiation and conditions of microgravity on the human hematopoietic/immune system, using unique in vitro and humanized mouse model systems. The ultimate goal of this work is to define the risk of leukemogenesis astronauts will face during long-duration missions in deep space (such as those NASA has planned to the Moon, near-Earth asteroids, and Mars) and developing effective countermeasures to keep astronauts safe.

Adrienne Provenzano (*Tuesday afternoon session 1*)



Adrienne Provenzano is an accomplished musician and arts integration specialist who connects the arts and humanities with STEM subjects through multidisciplinary education experiences, programs, and projects, including original music compositions inspired by the International Space Station. As a volunteer NASA/JPL-CalTech Solar System Ambassador and CASIS Space Station Explorers Ambassador, she leverages a universe of possibilities to engage and inspire learners. She has presented at the Kennedy Space Center, UN Women Headquarters, Space Center Houston, the Smithsonian Institution National Air and Space Museum, and the National Astronomical Observatory of Japan.

Ana Cristina Galhego Rose (Dipteron UG) (*Tuesday evening session*)

Lawyer and entrepreneur, Ms. ROSA has over 10 years of experience in the space sector. She is currently Founder and CEO of her German company DIPTERON UG, located in Darmstadt, Germany. The company develops a platform for detecting risk areas of Aedes mosquito, which is responsible to transmit Dengue, Zika and Chikungunya diseases.

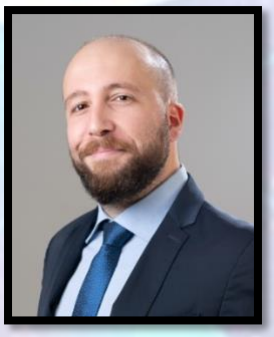
The platform is based on artificial intelligence that combines data from remote sensing satellites and other field data. The project has already won awards (SAP-European Space Agency (ESA) App Challenge winner 2015; ESA EOEI Call 2016; ESA Copernicus Master competition finalist 2016), incubated at ESA Business Incubation Center in Darmstadt, Germany, 2017); and recently was selected to the PARSEC Accelerator program of the European Commission 2020. In Brazil, in partnership with the company VISIONA TECNOLOGIA ESPACIA S.A has been developing a pilot project for the Brazilian city of São José dos Campos.

Ms. ROSA has extensive knowledge in the space sector. She worked at the United Nations Space Affairs Office (UNOOSA) and the European Space Policy Institute (ESPI), both in Vienna, Austria. Since 2008, she has served as a consultant member of the Brazilian delegation during the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS). She holds a postgraduate degree in international law and international trade law, a master advance degree in air and space law and the prestigious Space Studies Program of the International Space University (ISU). Ms. ROSA is member of the International Institute of Space Law (IISL), Women Aerospace in Europe (WIA-Europe) and the Brazilian Association of Air and Space Law (SBDA). Ms. ROSA has published articles in the space sector and throughout her career won 14 awards.

Professor Thais Russomano (Kings College London | Co-founder and CEO, InnovaSpace UK) (*Monday twilight session*)

Professor Thais Russomano has over 30 years of experience in Aerospace Medicine, Space Physiology, Telemedicine and Digital Health. She is an MD from Brazil, specialised in internal and emergency medicine, and has an MSc in Aerospace Medicine from the USA and a PhD in Space Physiology from King's College London. She worked for 3 years as a researcher at DLR, Germany, before establishing and coordinating the Microgravity Centre, PUCRS, Brazil for 18 years. She is academically linked to several universities, such as King's College London-UK, University of Lisbon-Portugal, and UFCSPA-Brazil. Thais is an Elected Academician of the International Academy of Aviation and Space Medicine, and the International Academy of Astronautics, for which she serves on the Board of Trustees. She is also a member of international associations and societies in space, aviation and telehealth, a Board Member of companies, and further holds patents related to Space Life Sciences and Aerospace Biomedical Engineering. Thais also currently acts as a voluntary Mentor for Space4Women, an initiative of the United Nations Office for Outer Space Affairs, and is the co-founder and CEO of InnovaSpace UK.

Antonino Salmeri (The University of Luxembourg | International Space University) (*Monday evening session)*



Antonino Salmeri is a Doctoral Researcher in Space Law at the University of Luxembourg, where he is pursuing a PhD on the enforcement challenges of space mining regulations under the supervision of Prof. Mahulena Hofmann and with the support of the Luxembourgish National Research Fund.

Antonino is also a qualified attorney registered at the Italian BAR, holds three master degrees in law and is active member of many organizations in the space domain. Inter alia, he is:

- Co-Lead of the Space Exploration Project Group within the Space Generation Advisory Council, where he is also the Lead of the E.A.G.L.E. Action Team on Lunar Governance;
- An individual Governing Member of the International Space University, where he graduated as second-best participant of SSP19 and where he recently served as Mentorship Officer for the 2020 Interactive Space Program;
- Member of the International Institute of Space Law, as well as of the Moon Village Association; and
- Observer of the former Hague Working Group on Space Resources.

Dr Josef Schmid (Flight Surgeon, NASA | Major General, United States Air Force Reserves) (*Monday morning opening session*)

Dr Josef Schmid is a Flight Surgeon at NASA and a Major General in the United States Air Force Reserves. He is the former lead for Space Medicine Training, responsible for training medical students, other flight surgeons, astronaut crew medical officers and biomedical engineers, former Lead for the Electronic Medical Record system and previous Co-director for the Aerospace Medicine Residency at the University of Texas Medical Branch, Galveston. He is a qualified flight crewmember for the supersonic T-38 jet trainer, Shuttle Training Aircraft, Microgravity flights and ISS Direct return G3 and G5 missions. Dr. Schmid became an aquanaut during a 12 day mission to NOAA's undersea Aquarius habitat during NASA's NEEMO 12. Dr. Schmid has been a crew surgeon for shuttle missions STS-116, STS-120, STS-126 and for multiple long duration missions to the International Space Station including Soyuz launches and landing operations in Kazakhstan for expeditions 18, 24, 29, 39, 48, 56, and 63. Lastly, Dr. Schmid is the Lead for vehicle development and medical operations for the new Orion vehicle that will return humans to the Moon.

Andrew Simon-Butler (The *Jus Ad Astra Project*) (*Tuesday morning session*)

Andrew is a Canadian Barrister and Solicitor, Australian Lawyer and Australian Registered Migration Agent. His research focus is the forthcoming intersection of international migration law and international space law governing the future human settlement of outer space. His recent publication, 'Freedom of Movement in Outer Space as an Individual Human Right', can be found in volume 42 of the Annals of Air and Space Law.

He has completed a Master of Research from Macquarie University examining the Outer Space Treaty from an international migration law perspective, as well as the Strategic Space Law Program at McGill University. In addition to his Juris Doctor from the University of Melbourne, he also holds two Master of Laws degrees and Graduate Certificates in both Migration Law and Space Studies.

As an alumnus of the International Space University's (ISU) Southern Hemisphere Space Studies Program (SHSSP), Andrew has served as academic staff on multiple ISU programs. These include as Associate Chair (SSP19 Strasbourg, SHSSP18 Adelaide) and as a Teaching Associate (SSP17 Cork).

Vienna Tran (Medical Student, University of Adelaide | Symposium Co-Host)
(*Monday and Tuesday twilight sessions and Tuesday evening session*)

Vienna is a medical student at the University of Adelaide. This year she is doing an Honours project about bedrest and muscle health in collaboration with ESA and the UK Space Agency. She is the 2020 class representative of the International Space University's Southern Hemisphere Space Program (ISU SH-SSP), and a graduate of National Space Camp. Her other interests are environmental advocacy and long-distance running. Her favourite space movie is 2001: A Space Odyssey.

Hardam Tripathi (The *Jus Ad Astra Project* | Trip Law, P.A.) (*Tuesday morning session 1*)

Attorney Hardam Tripathi exclusively practices U.S. Immigration & Nationality Law and is the Founding Attorney at Trip Law, P.A. Tripathi earned his Juris Doctorate from Western Michigan University where he served as an Associate Editor on the Homeland and National Security Law Review focusing on geopolitical issues.

Prior to launching his own law practice, Tripathi worked as a Rule of Law professional with the U.S. Department of State and as a Law Clerk with the U.S. Air Force JAG Corps, where he found his passion for the intersection of law and space. Tripathi devotes a significant amount of time encouraging best practices with respect to Sustainable Development Goals within the UN framework for various legal and policy issues, and has regularly met with members of Congress to advocate for the authorization of higher levels of funding for appropriations related to various initiatives.

Dr Shane Usher (Research Fellow, Department of Chemical Engineering, University of Melbourne)
(*Monday afternoon and Tuesday morning sessions*)

Dr Shane Usher is a Research Fellow in the Department of Chemical Engineering at The University of Melbourne, Australia. He has a Bachelor of Science, Bachelor of Engineering(Hons) and a PhD; all from the University of Melbourne. Shane has published over 50 research papers in the areas of rheology and dewatering processes.

Shane is a keen athlete and has had significant success in rowing, where he has broken world records on the Concept2 rowing machine over distances ranging from 100 metres to over 100 kilometres and also holds two Guinness World Records for being part of a crew that rowed across the Indian Ocean in 2014.

Shane was the Crew Engineer in “Expedition Boomerang”, an Australian crew at the Mars Desert Research Station in Utah in 2019, where he considered the long term sustainability of Martian habitats. He is also a potential candidate for SIRIUS-21, an 8-month analogue space mission at the Institute of Biomedical Problems in Moscow where he plans to research the impact of “Rowing in Space” on the maintenance of bone density and muscle mass. Shane is also researching the potential use of “Scattering to enhance radiation shielding” and walk-in vacuum chambers; all to help establish an enduring human presence in outer space, our Moon, Mars and beyond.

Dr Angelo Vermeulen (Delft University of Technology | SEADS) (*Tuesday afternoon and evening sessions*)

Angelo Vermeulen is a space researcher, biosystems engineer, biologist and artist. He works on bio-inspired concepts for interstellar exploration at Delft University of Technology, bringing together a variety of disciplines. Since 2009 he has been collaborating with the European Space Agency's MELiSSA program on biological life support. In 2013 he became the first crew commander of the NASA-funded HI-SEAS Mars simulation program in Hawai'i. Vermeulen co-founded SEADS (Space Ecologies Art and Design), an international transdisciplinary collective of artists, scientists, engineers, and activists. In 2019 SEADS received the International Award for Public art and launched its first artwork to the International Space Station. Vermeulen has been (guest) faculty at several universities across Europe, the US, and Southeast Asia.

Aude Vignelles (Executive Director Program and Capability, Australian Space Agency) (*Monday morning opening session*)

Aude Vignelles is the Executive Director, Program and Capability, of the Australian Space Agency. As part of the senior executive team, Aude leads and is responsible for writing the civil space strategy roadmaps, scoping and managing the Agency's space programs and delivering on domestic and international activities. She provides an in-depth understanding of the national and international space industry, program management expertise and a breadth of space science or systems engineering skills. Prior to this role, Aude was the Executive Manager, Satellite and Fixed Wireless Operations at nbn. Previously, Aude held senior and executive roles within Foxtel, Austar, Telstra, and Technicolor. Aude is a space and aeronautics engineer (graduating from ENSICA, Toulouse) who started her career at the European Space Agency in the Netherlands. Her 30 years of experience in delivering large and complex programs embrace the introduction of new technology in the telecommunication, space and media industries. Aude has been living in Australia for the past 20 years and has contributed to the Australian space capability through White Papers, events at conferences with the growing start up community in Australia, and promotion for Women in Space and Engineering at universities.

Associate Professor Justin Walsh (Department of Art, Chapman University) (*Tuesday afternoon session 2*)

Dr. Justin Walsh is associate professor of art history and archaeology at Chapman University (California, USA) and a Registered Professional Archaeologist with more than two decades of experience. He has excavated sites in the US, Spain, Jordan, and Italy, and currently directs the Chapman Excavations at Cástulo project at a Iberian and Roman site in Andalucía. He is also co-PI of the International Space Station Archaeological Project and has published research in the field of space archaeology since 2009. In general, his research has been most concerned with the transmission of ideas and goods between cultures. Among the honors he has received are a Rome Prize and a Fulbright scholarship to Greece. In 2016, he was Benjamin Meaker Visiting Professor at the University of Bristol.

Melanie Ward (Flinders University) (*Symposium Co-Host and online logistics coordinator*)

Melanie is a science communicator currently studying at Flinders University in a Bachelor of Science (Computer Science), and she is passionate about aerospace, renewable energy, archaeology and the space sciences. Melanie graduated from Flinders University in September of 2020 with a Bachelor of Archaeology. Her time away from studies is invested in an ongoing engagement with STEM outreach initiatives across Australia with organisations like the American Institute of Aeronautics and Astronautics (AIAA) as Young Professionals Officer and on the General Council of Computer Applications and Quantitative Methods in Archaeology - Australasian Chapter. Melanie's experience outside of degree work also includes the Horizon Professional Development Award, leading Business Operations for the Flinders Automotive Solar Team's 2019 bid for the Bridgestone World Solar Challenge, and being coordinator for speakers on campus related to events in space, STEM or professional development.

Dr Anne Weiss (Educator Professional Development Specialist, NASA Langley Research Center) (*Tuesday morning session 2*)

Dr. Anne Weiss is the Educator Professional Development Specialist at NASA's Langley Research Center in Hampton, Virginia, US, where she facilitates both online and face-to-face educator workshops and student engagement events. In a quest to fulfill a lifelong dream of flying in space, Anne originally trained as a neuroscientist, including research work characterizing DNA repair genes (e.g., XRCC2 and XRCC3) and their role in cancer at the U.S. Department of Energy's Los Alamos National Laboratory. Later, Anne examined how chronic stress may contribute to nervous and endocrine system dysfunction (e.g., human atypical depression) using Siberian dwarf hamsters (*Phodopus sungorus*) as a model organism.

Since 1998, Anne has taught Earth science, chemistry & biochemistry, physical science, and biology at both the K-12 and postsecondary levels; she currently holds an appointment as adjunct professor of human anatomy and physiology at Tidewater Community College. As a result of her teaching experiences, Anne's research interests include K-12 student retention in science and mathematics as well as science education policy. These interests were expanded in 2010 when Anne earned a graduate research assistantship with NASA's Aerospace Education Services Project (AESP), serving as Community Manager of the NASA Educators Online Network (NEON) professional learning community. This international resource eventually became the subject of her dissertation on educator retention in online professional development and learning. Anne earned a bachelor's degree in vertebrate physiology (with history minor) from Penn State University, a Master's degree in physiology from Arizona State University, and a Ph.D. in Higher Education Administration (also) from Penn State University.

Earl White (Vice-President, Mars Society Australia) (*Session Chair, Monday afternoon session*)

Earl originally studied computer science at Macquarie University before embarking on a long career in the Australian IT industry across technical, sales and management roles. He ran the Australian operations of Internet technology pioneer, NASDAQ listed Quarterdeck Corporation as well launching and managing a number of both American and local software vendors. Earl became a lifelong astronomy and space fanatic after watching the Apollo 11 landings with the rest of his kindergarten class. He's worked in the astronomical telescope supply industry, blogged about astronomy and space since 2002 and recently started a podcast. Earl has post graduate qualifications in astronomy from Swinburne University and maintains a keen interest in planetary science and galaxy formation. He's the current vice-president and a director of the Mars Society Australia.

Markus Woltran (Office of the Director of the United Nations Office for Outer Space Affairs (UNOOSA)) (*Tuesday evening session*)

Markus Woltran is a Programme Officer in the Office of the Director of the United Nations Office for Outer Space Affairs (UNOOSA). He supports the Director of the Office in a broad variety of tasks and engages in diverse strategic and policy relevant areas such as #space4SDGs, interagency affairs, UNOOSA strategic directions and operational priorities (SDOP) as well as planning efforts. Additionally, he supports key activities and leads the organisation of international conferences, workshops, expert meetings and symposia. Markus is also in charge of the office's engagement on the implementation of a dedicated 'Space for Women' Project. He also supports different UNOOSAs outreach and awareness raising activities as well as contributes to papers and other written products and publications. Markus has an experience as Associate Programme Officer in the UNOOSA programme on Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER) as well as in the United Nations Information Service (UNIS) and in the Austrian Foreign Ministry. Markus holds a master's degree in political science.

Speaker abstracts (in order as per the program)

Monday 5 October

Monday Morning Opening Session (08:45 to 11:00 AEDT | 17:45 to 20:00 EDT | 23:45 to 02:00 CEST)

Keynote presentations
Themes: Space4Health and #Satellites improve life

***Session Chair*: Dr Rowena Christiansen**

Aude Vignelles (Executive Director Program and Capability, Australian Space Agency): ***Australian Space Agency Updates***

Created in July 2018, the Australian Space Agency has opened international doors, published the Civil Space Strategy, funded key space infrastructures for the nation, kicked off International Space projects and started the Moon to Mars program. This presentation will provide some details of the highlights of these past 2 years.

Dr Josef Schmid (Flight Surgeon, NASA | Major General, United States Air Force Reserves):
NASA Flight Surgeon: Medicine in Extreme Environments (and Flying with your Patients!)

NASA Flight Surgeons are physicians who care for Astronauts and their families on and off the planet. Space Medicine is a branch of Aerospace Medicine combining preventive and occupational medicine and performed in the extreme environment of Space. Space Medicine is also the ultimate in Telemedicine where the patients are often traveling in orbit, some 210 miles (or 338 km) above us and at 17,500 miles (28,160 km) per hour. NASA Flight Surgeons routinely work in diverse places such as the Johnson Space Center mission control, training facilities in the United States and Russia and launch and landing facilities in Florida and Kazakhstan. NASA Flight Surgeons are on the teams designing future space vehicles such as Orion as well as commercial missions with SpaceX and Boeing. Dr. Schmid will discuss the training required for this career and the Trust required to take care of these exceptional patients and missions. Lastly, Dr. Schmid will offer suggestions for physicians and others to join in these efforts and possibly develop their own expertise in medicine such as space analogs like the extreme environments that are present in several places in Australia.

Professor Andy Koronios (CEO, SmartSat CRC):
SmartSat CRC: Building the Australian space ecosystem through cooperation, collaboration and partnerships

The global democratisation, commercialisation and disruption of space, is presenting Australia with a rare opportunity to further build its space capabilities. Australia has had a strong heritage in a number of space-related fields such as deep space communications, space situational awareness, robotics and in space medicine. It has also very recently been given a privileged opportunity to participate in and contribute to the next wave of space exploration to the Moon, Mars and beyond. As a small economy and space contributor in the global space ecosystem, Australia needs to do what it does best, achieve more with less. We can make a contribution in a number of space science and technology areas through cooperation, collaboration and partnerships leveraging existing capabilities, identifying strengths and working together in seizing this significant opportunity of NewSpace. This presentation will report on the SmartSat journey activities and future vision for Australia's success in space through collaboration.

John Haynes (Program Manager, Health and Air Quality Applications, NASA):
Utilizing Earth Observations to Inform Health and Air Quality Management Decisions

NASA utilizes its fleet of more than 20 satellites and sensors in low-Earth orbit to provide real-time data about Earth's climate, environment, and weather for research and applications purposes. These data examine the temporal and spatial variation of an array of environmental factors within our global ecosystems. This presentation will provide an overview of NASA remote sensing data and technology that can detect environmental health threats and inform health and air quality management decisions. It will highlight the significance of cross-cutting applied environmental health research using Earth observation data.

Dr Helena Chapman (Associate Program Manager, Health and Air Quality Applications, NASA):
Using Earth Observations to Enhance Public Health Surveillance

Emerging environmental health risks, such as air pollution and vector-borne disease transmission, can affect ecosystem health. The One Health concept, which describes the interconnectedness between humans, animals, and the environment, can provide a framework to promote transdisciplinary collaborations that address these complex global challenges. Earth observation data offer innovative, real-time information for researchers and practitioners to gain insight on how these emerging environmental risks affect human and animal health. This presentation will describe two public health applications that use Earth observation data to advance scientific inquiry. It will highlight the Group on Earth Observations Health Community of Practice as a global network of researchers and practitioners who use Earth observation data to improve health decision-making.

Monday Morning Session 2 (11:15 to 12:45 AEDT | 20:15 to 21:45 EDT | 02:15 to 03:45 CEST)

Theme: Space Surgery

***Session Chair*: Dr Tovy Kamine**

Presenters and panel participants:

Professor George Pantalos (Professor of Cardiovascular and Thoracic Surgery and Biomedical Engineering at the University of Louisville):
A brief history of efforts to develop surgical capabilities for exploration spaceflight

The ability to surgically treat trauma and other disorders during a space mission requires a combination of utilizing current resources and procedures augmented by emerging innovations and the understanding the unique challenges of operating in a reduced gravity environment. Key contributions by several research and development efforts spanning four decades will be presented to stimulate thoughts for the further advancements that will be needed.

Dr Danielle Carroll (TRISH/UC San Francisco Space Health Innovation Fellow):
Prophylactic Surgery and Deep Space Travel

Prophylactic surgery before spaceflight has the potential to reduce the risk of conditions such as appendicitis and cholecystitis in astronauts on deep space missions. However, surgical prophylaxis comes with its own hazards, some of which may outweigh the benefits of these interventions. In this talk, we will explore the components of the risk-benefit analysis with additional insights gained from probabilistic risk assessment using NASA's Integrated Medical Model.

Dr Danyal Fer (University of California | USAF)**: *How Can We Do Surgery on Mars?***

While astronaut training, candidate screening and medical therapies should always be emphasized as first line solutions in preventing surgical disease from disrupting future mission success, the necessity to perform technical intervention on individuals visiting the Moon and Mars will arise. One of the critical barriers to providing surgical care in extreme environments is the distance separating technical and decision-making expertise from the patient. When Stanford Research Institute, in partnership with NASA and DARPA, developed one of the first soft tissue manipulating robots in the 1990s the intent was to create the capability to perform technical intervention at a distance. With few exceptions, these technologies have resulted in few operations being performed from kilometres away much less in space. This is not due to lack of effort but due to barriers in technology which are beginning to fall. In this discussion we will examine where we have been regarding robotic assisted surgery and what will be required in the future in order to bring robotic surgical procedures to red planet and beyond.

Dr Arthur Formanek (Brigham and Women's Hospital, Boston | Harvard Medical School): ***Avoidance of Venous Air Embolism in Spaceflight: Development of a Novel MIcrogravity Air-Trap***

A. *A. Formanek[1]*

B. *Institutions: 1. Anesthesiology, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States.*

Introduction: *Without gravity to separate fluid from gas, intravenous solutions form a "foamy" consistency in microgravity. Currently available terrestrial air-traps rely on gravity to separate gas from fluid, and inline air filters are incompatible with blood and high flow transfusion. We developed a non-gravity dependent inline air-trap to facilitate blood or rapid transfusion in microgravity.*

Methods: *An inline air-trap relying on centrifugal force to separate gas from fluid was 3D printed with nylon, and a latex membrane and membrane filter were applied post-production. Fluid enters the filter housing and is accelerated around a hollow core surrounded by a 150µm membrane filter. The less-dense gas is forced into contact with membrane filter and is vented from the device. Furthermore, baffles inside the filter housing increase the number of rotations performed by the fluid. In addition, the latex membrane allows for an expandable internal chamber that accommodates both high and low flow rates. The air-trap was tested against commercially available single and parallel Braun 5µm air eliminating filters and a previous prototype with no baffles or latex membrane for flow rate and success in filtering slow and fast boluses of air. Driving force for the IV fluid was created by suspending a liter of 0.9% saline solution at 125cm and inflating a pressure bag to 0mmHg, 150mmHg, and 300mmHg. Lastly, the centrifugal air-trap was tested in different orientations to confirm results were independent of gravity.*

Results: *At 125cm H_2O, the single Braun filter eliminated 85% of air given in a slow bolus, while two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter eliminated 100% of slowly bolused air. In the fast bolus, the single Braun filter, two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter eliminated 4.2%, 26.7%, 39.2%, 68.3%, and 99.6% of air, respectively.*

At 150mmHg, the single Braun filter, two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter removed 67.5%, 99.2%, 100%, 90.8%, and 100% of slowly bolused air, respectively. In the fast bolus, the single Braun filter, two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter eliminated 0.8%, 13.3%, 22.5%, 86.7%, and 94.2% of air, respectively.

At 300mmHg, the single Braun filter, two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter removed 3.3%, 35%, 80%, 90.8%, and 92.1% of slowly bolused air, respectively. In the fast bolus, the single Braun filter, two filters in parallel, three in parallel, single chamber centrifugal filter, and baffled centrifugal filter eliminated 1.7%%, 3.3%, 11.7%, 85.8%, and 77.5% of air, respectively.

Discussion: *The centrifugal filter compared comparably to the commercial inline filter at low flow rates and pressure but performed significantly better at high flow. It is also worth noting that the commercial filter is incompatible with blood at any flow rate. The tested device is also only a proof of concept and needs to be optimized to improve flow rates and further improve air-elimination.*

Dr Peter Lee (Assistant Professor of Pathology and Laboratory Medicine at Brown University): ***Considerations for the Development of an Advanced Medical and Surgical System for a Future Lunar Base***

As plans are currently underway for humans to return to the moon, we must also begin to think about the medical care that will be required to support a permanently manned lunar base of the future. Considering the moon's hazardous and remote environment a comprehensive medical system that includes basic surgical capabilities will likely be required. This presentation provides an overview of key considerations that should be considered for such a lunar medical system.

Monday Afternoon Session 1 (13:30 to 15:30 AEDT | 22:30 to 00:30 EDT | 04:30 to 06:30 CEST)

Theme: *"How to live on the Moon and Mars"*

Session Chair: **Earl White**

Presenters and panel participants:

Dr Jonathan Clarke (President, Mars Society Australia | UNSW | Centre of Excellence in Astrobiology, Amity University | Swinburne University of Technology): ***Selecting sites for the first crewed missions to Mars***

Astronauts working on the surface of Mars will need to have the capability to explore efficiently, rapidly, and flexibly, allowing them to perform a wide range of field investigations. The Meridiani area is an excellent candidate for the first missions to Mars and typifies the issues that need to be satisfied for such regions. It is accessible, safe, contains potential water resources in the form of poly-hydrated magnesium sulphates, has diverse science features with high likelihood of meeting all science goals, has other potential resources and potential for further longer-ranged exploration. The presence of hardware from previous missions will be of benefit to studies of materials to Martian conditions, assessing the effectiveness of historic planetary protection strategies, and engaging public interest. Lastly, parts of the Meridiani region have been well studied from the surface by the Opportunity mission, providing ground truth for orbital data. As one of the best documented regions of Mars this will allow a "Go where you know" approach for the first crewed missions, especially with regard to safety, trafficability, and water resource potential.

Dr Michaela Musilova (Director for HI-SEAS at the International Moonbase Alliance): ***Missions to the Moon and Mars at the HI-SEAS research station***

The Hawaii Space Exploration Analog and Simulation (HI-SEAS) habitat is a lunar and Martian analog research station located on the active volcano Mauna Loa in Hawaii. It is known for NASA-funded long duration simulated missions to Mars. As of 2018, missions at HI-SEAS have opened up to space agencies, organizations and companies worldwide to take part in, provided their research and technology testing will help contribute to the exploration of the Moon and Mars. Mission crews are supported by a Mission Control Center based on the Big Island of Hawaii as well. The surroundings of the HI-SEAS habitat are covered in lava and they contain very interesting geological features from a planetary science perspective, such as lava tubes. Research at HI-SEAS is thus focused on geological, astrobiological and architectural projects relevant to living and working on the Moon and Mars; as well as technological tests using drones, 3Dprinters and rovers; and performing outreach and educational projects. The research and technological experiments conducted at HI-SEAS are going to be used to help build a high fidelity Moon base simulator in Hawaii, and ultimately to establish an actual base on the Moon. Such technology testing will include closed-loop systems, in situ resource utilization, construction of agricultural systems and other sustainable processes at HI-SEAS. Future missions at HI-SEAS will be in collaboration with ESA, NASA, University of Hawaii and with companies, such as SIFT and Ketone Technologies.

Guy Murphy (Director, Mars Society Australia): ***Expedition Boomerang***

Expedition Boomerang was a four-week mission to the Mars Desert Research Station in Utah during the 2019/2020 field season. It comprised two fortnightly crew rotations, Crew 214 (October 26 - November 8, 2019) and Crew 215 (November 9 - November 24, 2019). Each rotation was undertaken in a full simulation mode.

Expedition Goals

The purpose of the expedition was to:

- *provide a new generation of Antipodeans with an opportunity experience a full analogue Mars mission;*
- *advance allied research projects across multiple disciplines; and*
- *foster collaborative partnerships between organisations and individuals.*

Dr James Kurrle: ***Bridging the gap: bringing space medicine and engineering together at the Mars Desert Research Station***

The Mars Desert Research Station has long been used for simulations, however for the past few years it has also been used with teams of doctors and engineers to teach space medicine in a hands-on environment.

Dr Siddharth Pandey (Head of the Centre of Excellence in Astrobiology, Amity University, India | Mars Society Australia): ***Analogue Research in India***

The talk will highlight the two foremost regions in India currently being studied to help Astrobiology and Moon-Mars Habitability studies. Ladakh in Himalayas- a cold, high altitude dry desert environment with a diverse set of astrobiology-relevant sites (glacial sediments, permafrost, saline lakes, hot springs) and Lonar Crater- a basaltic impact crater site with delta fan, ejecta and gullies that can help train for aerial investigations in Mars crater (e.g. Jezero Crater Exploration by NASA Mars 2020 rover).

Dr Shane Usher (Research Fellow, Department of Chemical Engineering, University of Melbourne): ***"Rowing in Space": proposed research at the Institute of Biomedical Problems, Moscow***

With the success of the Apollo Moon landings, it seemed a natural extension to assume that humans would soon be exploring the solar system to Mars and beyond. However, in the ensuing five decades, humans have been restricted to low Earth orbit. We have failed to develop confidence in our capacity to support life in deep space outside the protection of Earth's magnetic field, on Moon, Mars or beyond. There is currently no operational human life support infrastructure outside low Earth orbit.

Many terrestrial analogue facilities have been developed to mimic the hostile environments of space, the Moon and Mars. The isolation chamber facility at the Institute of Biomedical Problems (IMBP) in Moscow is one of the most famous, regularly conducting long-duration analogue space missions such as the 520-day Mars 500 mission in 2010-11. These missions are used to research a broad range of issues involving psychology, physiology, biology, microbiology, geology, engineering, monitoring and control of environmental systems.

A key NASA observation involving the physiology of long-term astronauts on the International Space Station (ISS) is that maintaining bone density and muscle mass is a significant challenge. In an upcoming 8-month isolation mission, SIRIUS-21, Australian researchers, Dr Shane Usher, Dr Rowena Christiansen and Dr Kathryn Stok, will be investigating the impact of "Rowing in Space" on the maintenance of bone density and muscle mass. Comparison will be made against the use of a treadmill and other exercise equipment supplied by Russian, American and German researchers by quantifying physiological changes including ultrasound measurements. The goal is to better understand the impact of various exercise regimes to help enable a sustained and healthy human presence in space, on the Moon, Mars and beyond.

Monday Afternoon Session 2 (15:45 to 16:45 AEDT | 00:45 to 01:45 EDT | 06:45 to 07:45 CEST)

Theme: Workshop on *Living on Mars: The Draft Constitution for Off-Earth Settlement*

Annalea Beattie (Mars Society Australia | RMIT University | Centre of Excellence in Astrobiology, Amity University, India)

This workshop combines a discussion about the future with a drawing activity to examine what assumptions can be made about the well-being of a developing democratic and civil extra-terrestrial society living on the hostile surfaces of celestial bodies such as the Moon and Mars. Our session addresses complex questions about how we might live together off-Earth, accounting for the extremities of the environment, the needs of a self-sustaining Martian settlement of over a thousand people, limited resources and the tyranny of isolation. The uniqueness of the Earth's biosphere, the lessons we have learnt on Earth and the basic legal framework of international space law will inform our thinking. The aim of our workshop is to begin to consider how we might formulate a draft position for the conditions of social freedom when future settlements in space are eventually established off-Earth.

The following brief will help participants understand what is required to participate:

How will you survive on Mars? When the outside environment is poisonous and harsh, when it promises instant death, when you are confined inside your spaceship or in a habitat under constant surveillance in limited physical space with the same people every day, what do you need to ensure you are mentally and physically well and happy?

For this workshop you are invited to bring one or two objects (or ideas) that might be important for your own survival if you were living in a small community off-Earth. For example, you might need a special book or a football or a shell or a family photo or an activity. (No food please and not your phone as it won't work on Mars or the Moon. And no pets please). Think of something that is essential for you to take to Mars and be prepared to draw and speak about that object. Or you might just bring some good ideas. You will need paper, a pencil, a sharpener and an eraser. From our workshop, we will construct some basic principles for a draft constitution for off-Earth settlement to help us understand how people might live together differently on surfaces of other planets.

Monday Twilight session (17:00 to 19:00 AEDT | 02:00 to 04:00 EDT | 08:00 to 10:00 CEST)

Theme: *"How to live on the Moon and Mars"*
Theme: Space Psychology and Space Physiology

Session Chair: **Dr James Kurrie**

Konstantin Chterev (Space Psychologist Lead at SAGA Space Architects):
LUNARK: A Marriage of Architecture and Psychology

Soon humans will face the Moon again. This time not to place a flag, but to live. If humans are to settle on the Moon and other planets, we must be very careful with how we design the homes for these pioneers. In space, your habitat is your entire world. There is no nature, change of scenery, or newness. It's just you and your pod.

If the designs continue to be sterile survival machines, the astronauts who have to live there for months at a time will wither from the lack of nature and sensory stimulation. Previous research shows that lack of stimuli, isolation, and confinement will become major challenges for the long-term voyages of the future.

SAGA Space Architects have developed, and are currently testing in Greenland over a three-month period, a radically different Moon habitat where architecture helps to counteract monotony, claustrophobia and psychological stress. The LUNARK Expedition aims to understand what is truly important when living in isolation under these extreme conditions. As the architects feel a certain responsibility for the lives of these future settlers, they have taken it upon themselves to be fully immersed in the problem.

Professor Thais Russomano (Kings College London | Co-founder and CEO, InnovaSpace UK):
How humans live in outer space – challenges and achievements

This lecture gives an overview of some of the physiological and anatomical changes that occur in space, their effects on different body systems, such as the cardiovascular and musculoskeletal, countermeasures used by astronauts during a space mission, and also presents relevant aspects related to psychosocial aspects of leaving behind the safety of Earth. It further addresses the complexity of human space flight, plans for trips to Mars, construction of habitats on the Moon and the popularization of space tourism. It also shows how interdisciplinary this topic is and discusses the challenges that space physiologists, physicians and scientists must face as humans seek to conquer the final frontier.

Presenters and mini-panel participants:

Dr Bergita Ganse (Research Fellow, Manchester Metropolitan University):
Musculoskeletal research in bedrest studies

Bedrest studies with 6 degrees head-down tilt are a useful spaceflight analog often employed to test the efficacy of countermeasures to attenuate physiological changes caused by weightlessness. With regard to the musculoskeletal system, human spaceflight is among other things associated with losses in muscle strength and mass, bone mineral density and an increase in the height of intervertebral discs associated with "Space Adaptation Back Pain". This talk will give a short introduction to the types and implementation of bedrest studies and show examples of countermeasures tested over the past years. It will also present research findings from the musculoskeletal experiments we have conducted in bedrest studies, including research on intervertebral discs and neuromuscular interaction.

Vienna Tran (Medical Student, University of Adelaide | Symposium Co-Host):
The Effects of Centrifugation on the Gluteal Muscles During 60-Day Bed Rest

The project aims to investigate whether artificial gravity, achieved by short-arm centrifugation, effectively mitigates the deteriorations of the size and composition of the gluteal muscles following 60-day 6° head-down tilt bed rest. Of the 24 healthy human subjects, 16 volunteers spent thirty minutes daily in a centrifuge, which simulates normal Earth gravity on the body. The remaining volunteers received no centrifugation. The subjects' gluteal hip muscles were imaged before and after the trial. These images were compared to determine how bed rest and centrifugation affect the size and composition of the gluteal muscles. Preliminary results show that bedrest produces a differential impact on the gluteal muscles, however, the centrifugation does not mitigate muscle deconditioning. These results will have implications on future studies on muscle health for both astronauts and sedentary terrestrial patients alike.

Monday Evening Session (19:30 to 21:00 AEDT | 04:30 to 08:00 EDT | 10:30 to 12:00 CEST)

Theme: *"How to live on the Moon and Mars"* – human rights and governance considerations

***Session Chair*: Dr Bergita Ganse**

Dr Thomas Cheney (The Open University | Executive Director, Centre for a Spacefaring Civilization): ***Space Governance and Settlements***

Dr Cheney will give an overview of the space governance regime (including the Outer Space Treaty and associated instruments) and then discuss governance of space settlements themselves: this will include constitutional, political and ethical aspects.

Antonino Salmeri (The University of Luxembourg | International Space University): *Human Settlements in Space Between Space Law and Fundamental Rights*

Antonino will talk about existing laws and the legal considerations that need to be taken into account for the future in terms of human presence in space. He will also touch upon the concepts of non-appropriation, self-determination, privacy, and how this relates to both non-autonomous and autonomous settlements. His talk will establish the groundwork for the following workshop.

Workshop: *Human rights in the space environment*
Coordinator: Deepika Jeyakodi

Timings:

- *05 minutes introduction to the workshop.*
- *20 minutes of group discussion.*
- *20 minutes of plenary discussion (3 teams x 5 mins each) (+ buffer time if needed)*

Participants will be divided into three (or more) groups via Zoom "breakout rooms" (with facilitators) and allocated one of the following settings:

- *Setting 1: Pioneering inhabitants ~100 persons who rely on Earth for their sustenance.*
- *Setting 2: Early settlers ~ 1000 persons who rely on Earth + have their own resources/sustenance.*
- *Setting 3: Residents ~10000 persons who are self-sustaining.*

As there may be a large number of people in each room it will be important to have someone leading the discussion and to also appoint someone to make notes and report back to the plenary.

Workshop Introduction: "*Mars is there, waiting to be reached*" - Buzz Aldrin

We are closer to human settlements in space than ever before. Even if not possible in the short term, we will someday become an interplanetary species. There are many challenges to overcome before this can become a reality: technical, scientific, financial,... but also legal and governance challenges that pertain to establishing a new society on another planet.

To what extent, Earth law should be binding for people permanently living on another celestial body? How can we create a sustainable environment in space for humanity to thrive? What rights and obligations should the inhabitants of space have?

Introduction to what law exists, and what legal challenges lie before us... Antonino Salmeri explains and gives food for thought as the space law expert. After this, the participants will be split into 3 groups:

- *Setting 1: Pioneering inhabitants ~100 persons who rely on Earth for their sustenance.*
- *Setting 2: Early settlers ~1000 persons who rely on Earth + have their own resources/sustenance.*
- *Setting 3: Residents ~10000 persons who are self-sustaining*

Each group will:

1. *Define their setting: Who are the people in their settlement? What does their settlement look like? What roles/functions do the people have? Who governs the people and activities? And how?*
2. *Develop a charter listing 3- 5 key human rights that fit their setting/demographic based on group discussions.*
3. *Present their charter and the rationale behind in the plenary for around 3 minutes. An additional couple of minutes will be reserved for questions from other groups.*

Tuesday 5 October

Tuesday Morning Session 1 (08:45 to 10:00 AEDT | 17:45 to 19:00 EDT | 23:45 to 01:00 CEST)

Theme: Human rights in the space environment

Session Chair: **Dr Shane Usher**

Presenters and panel participants:

Jonathan Lim (The *Jus Ad Astra* Project | Solicitor, WiseLaw): ***The Right to a Breathable Atmosphere***

The achievement of human health and well-being in the context of outer space represents a unique challenge, requiring the consideration of the physiological, technical, and policy aspects of human activities across the final frontier. The notion of health as a foundational element of human rights is given its centrality to human dignity, and necessity for the full-realisation of associated human rights values and principles conducive to just realization of life, liberty and the pursuit of happiness. Herein, it is advanced that the Right to a Breathable Atmosphere (RBA) exists as an integral element to maintaining the Right to Health (RTH) in space. The advancement of RBA as a non-derogable and absolute human right is key to protecting the right of every individual to life, safeguarding the rights of children, and promoting human development in the outer space environment. It is evident that the advancement of this novel right mandates a human rights-based approach, to facilitate its compulsory adoption by governments and businesses alike across their human spaceflight activities over the coming decades.

Hardam Tripathi (The *Jus Ad Astra Project* | Trip Law, P.A.):
Human rights violations within the Chinese space program

Hardam's presentation will draw upon his work encouraging best practices with respect to Sustainable Development Goals within the UN framework for various legal and policy issues.

Andrew Simon-Butler (The *Jus Ad Astra Project*): ***Freedom of Movement and Mobility Rights in Outer Space***

The contemporary global regime of closed borders, involving discretionary state control of immigration and cross-border movement, cannot simply be transplanted to the future human settlement of outer space. For Article I of the Outer Space Treaty declares space "shall be free for exploration and use by all States without discrimination of any kind … and there shall be free access to all areas of celestial bodies." The potential development of an open border regime in outer space, involving freedom of movement as an individual human right, could therefore become one of the most unique and important governance features of the space domain. Such a development would not only promote equality of opportunity and the personal autonomy of all, but ensure that mobility rights in outer space are not premised upon the "birthright lottery" of nationality long prevalent here on Earth.

Theodore Nastase (The *Jus Ad Astra Project*): ***Human rights violations within the Soviet space program***

I will be discussing the Soviet Space Program and what that can teach us about human rights, or more specifically, what happens when you don't consider human rights in your space program. And when I say human rights, I mean a consideration for humanity, for what connects us, and the rules and laws we place to protect that connection. I want to go over some of the failures and successes of the program, and also the overarching goal of the program to shed light on how we might want to move forward considering human rights in space.

(Disclaimer regarding this session: "The Symposium sponsors, Mars Society Australia and the ad astra vita project, would like to raise awareness that human rights issues, and in particular singling out one particular person or State, has the potential to be contentious, or even to cause offence, and can cause other similar examples to be overlooked. It is important to discuss human rights issues, both on-or-off-world, but it is not the intention of the sponsors to engage in political commentary through including these issues as part of the Symposium. As such, the sponsors would like to provide a disclaimer that the views are those of the presenters and that these do not represent policy statements by the sponsoring bodies.")

Tuesday Morning Session 2 (10:15 to 12:15 AEDT | 19:15 to 21:15 EDT | 01:15 to 03:15 CEST)

Theme: Space radiation research

***Session Chair*: Dr Jonathan Clarke**

Presenters and panel participants:

Dr Anne Weiss (Educator Professional Development Specialist, NASA Langley Research Center): ***Countdown to NASA Artemis – One Small Step to the Moon, One Giant Leap to Mars***

More than 50 years after Project Apollo's historic achievement, NASA is preparing to send the first woman and the next man back to the Moon by 2024. Named for the mythical Apollo's twin sister, the Artemis program aims to establish both a permanent surface base and a Gateway platform in orbit around our Moon in preparation for eventually sending astronauts on to Mars. Yet beyond the protection of Earth's magnetic field, space radiation will stand as one of the bigger challenges to maintaining the health and well-being of our astronauts as they travel to, live and work at, and finally return from these destinations beyond low Earth orbit. In October 2020, we celebrate 20 years of continuous human presence aboard the International Space Station (ISS), a key stepping-stone to achieving NASA's objectives for Artemis. This presentation will provide a brief introduction to ISS biomedical research that furthers our understanding of the space radiation challenge, possible methods for mitigating it during long-duration human spaceflight, and applications to Earth-based medicine.

Professor Christopher Porada (Professor, Wake Forest Institute of Regenerative Medicine): ***TRISH-supported work investigating the effects of Mars mission-relevant doses and ions of simulated space radiation on the hematopoietic and gastrointestinal systems***

For the last 7 years, as a NASA- and NASA's Translational Research Institute for Space Health (TRISH)-funded investigator, I have been applying my knowledge of hematopoiesis and stem cell assay systems to define the effects of solar particle event and galactic cosmic ray radiation and conditions of microgravity on the human hematopoietic/immune system, using unique in vitro and humanized mouse model systems. The ultimate goal of this work is to define the risk of leukemogenesis astronauts will face during long-duration missions in deep space (such as those NASA has planned to the Moon, near-Earth asteroids, and Mars) and developing effective countermeasures to keep astronauts safe.

Dr Daniel Liang (CSIRO Manufacturing, High Performance Metal Industries Program**):** ***Space Radiation Shielding***

Space ionizing radiation is a significant risk to humans, electronics (including medical devices), chemical products such as medicines (of which chemistries and stability are critical), in the space environment.

In this presentation, currently available radiation shielding technologies and their working environments are highlighted. Their limitations and thus the need to develop next generation shielding technologies, from lightweight, miniaturisation, differentiation against high- and medium-energy radiation, to their technical scalability and overall integration, will be discussed. The CSIRO effort in developing radiation shielding materials and composite structures will be briefly introduced.

The successful development of radiation shielding technologies that are deployable and effective in a wide range of space working conditions will have profound impacts on current and future space exploration activities, such as prolonging the life space of satellites, in-orbit manufacturing, in-situ resource utilization, protecting humans in space stations, spacecrafts and habitats on Moon and Mars, and so on.

(Keywords: space, radiation shielding)

Dr Gail Iles (Senior Lecturer in Space Physics, RMIT University): ***Lightweight, active shielding technologies to protect astronauts against radiation***

Abstract: *The International Space Station currently uses passive shielding to protect astronauts against space radiation in Low Earth Orbit. Artemis will see the next generation of space explorers land on the moon, being exposed to much higher radiation levels compared to LEO. This talk will explore the technological solutions required to offer lightweight, electromagnetic, 'active' shields to protect astronauts in this high-dose radiation environment.*

Dr Shane Usher (Research Fellow, Department of Chemical Engineering, University of Melbourne): ***"Radiation, Vacuum and Microgravity": Addressing the shortcomings of terrestrial space analogues***

With the success of the Apollo Moon landings, it seemed a natural extension to assume that humans would soon be exploring the solar system to Mars and beyond. However, in the ensuing five decades, humans have been restricted to low Earth orbit. We have failed to develop confidence in our capacity to support life in deep space outside the protection of Earth's magnetic field, on Moon, Mars or beyond. There is currently no operational human life support infrastructure outside low Earth orbit.

Many terrestrial analogue facilities have been developed to mimic the hostile environments of space, the Moon and Mars. Two of the most famous facilities are the isolation chambers of the Institute of Biomedical Problems (IMBP) in Moscow (Mars 500 mission) and the Mars Desert Research Station (MDRS) in Utah (Mars Society). These missions are used to research a broad range of issues involving psychology, physiology, biology, microbiology, geology, engineering, monitoring and control of environmental systems. However, it is important to note that these facilities do not simulate reduced-gravity, vacuum pressures or high energy radiation, but we need to prepare for these challenges to enable a sustained human presence in space.

***Radiation**: Shielding through spaceship and spacesuit materials and design is the main focus of research to minimise radiation impacts, but "scattering" is a complementary phenomenon that can be exploited to minimise exposure and is worthy of further research.*

***Vacuum**: A new walk-in vacuum chamber in Tasmania is likely to be a valuable resource. Now, expanding this idea further, one proposal is to develop a transportable walk-in vacuum chamber on the scale of a shipping container to produce an affordable commercial product that significantly broadens the user base. There are a multitude of research applications including equipment certification, spacesuit testing, experience in a vacuum environment and even research simulating the surface of Mars or radiation induced plasma on the Moon.*

***Microgravity**: Terrestrial research on the impact of gravity has involved extended bed rest in foam, spacesuits underwater, suspended treadmill running and centrifugation, but none of these properly replicate the reduced gravity experienced in space on the Moon or on Mars. We have the "Vomit Comet" for very short term simulation, but the ISS is the best laboratory that we are not currently utilising to replicate the gravity experienced on the Moon or Mars. It could be investigated whether a small daily centrifugal acceleration comparable to that experienced on the Moon could alleviate many of the impacts of long-term microgravity exposure.*

Tuesday Afternoon Session 1 (13:00 to 15:00 AEDT | 22:00 to 00:00 EDT | 04:00 to 06:00 CEST)

Theme: *"Breaking down silos: how cross-discipline STEAM education benefits us all"*

***Session Chair*: Associate Professor Alice Gorman**

Adrienne Provenzano: ***Arts and Humanities: Their Vital Place in Space Exploration Ecosystems***

This presentation considers the role of the arts and humanities in both LEO (Low Earth Orbit) and Deep Space Missions. Historic missions as well as imagined future voyages provide insights regarding culture as an essential aspect of space exploration. Meaning making and artistic expression can be a conscious aspect of mission planning, training, realization, and legacy as humanity takes further small steps and giant leaps through human and robotic missions.

Presenters and panel participants:

Professor Phil Bland (John Curtin Distinguished Professor and Director of the Space Science and Technology Centre, Curtin University): ***Planetary science as a breadth subject at Curtin University***

When this new course started up a couple of months ago, over 100 students signed up, including young scientists who want to know about solar system formation and evolution and young engineers who want to know about mission science cases and solar system exploration. We even have students from commerce and the arts.

This unit provides an introduction to planetary science, focusing on the geology of planets and exploration of the solar system. Topics that will be covered include the history of solar system exploration, space missions and mission design, an introduction to cosmochemistry, sample return, analysis, meteorites, impact cratering, origin of life, exoplanets, and planetary/space resources.

(Information from LinkedIn and Curtin Online Handbook.)

Professor Virginia Kilborn (Dean of Science, Swinburne University of Technology): ***Multi-disciplinary Space Education: A new model at Swinburne***

The Australian Space Agency has set a target of tripling the space industry in Australia over the next ten years. At Swinburne, we are introducing a new Space Technology co-major to help address the skills gap. Our program allows students of any discipline - from Science and IT to Health and Business, to apply the skills they learn in their degree through industry-engaged projects, and targeted micro-units. I will discuss this new program and the advantage of multidisciplinary teams, along with Swinburne's SHINE student program, sending experiments to the International Space Station.

Dr Gail Iles (Senior Lecturer in Space Physics, RMIT University): ***The BSc Space Science at RMIT***

The Australian Space Agency has announced that Australia would need a workforce of 20,000 people in the space industry in the next 5-10 years. RMIT has sought to address that need by creating an exciting new 3-year bachelor's degree in Space Science. Students study a broad range of subjects in physics, maths, engineering and space and participate in real-life space challenges as practical activities. Several industry partners are involved with the degree ensuring that students have a wide range of workplace options after graduation.

Dr Siddharth Pandey (Head of the Centre of Excellence in Astrobiology, Amity University, India | Mars Society Australia): ***Breaking down silos: cross-discipline STEAM education***

The talk will cover cross disciplinary education and outreach events held in a classroom, field site and online on the topic of Astrobiology that helped bring together students and faculty members from various disciplines, regions and age groups to work together towards solving a common problem. The talk discusses the strong cohesiveness that existed within the group in these three different platforms and their effectiveness in breaking down the silos.

Naomi Norris (Lecturer, Department of Medical Education, University of Melbourne): ***Making Space for The Arts in Medical Education***

Prior to 2020, understanding and/or drawing on the ARTS to support Learning and Teaching of Medical students at the University of Melbourne was dependent on the knowledge, skill and inclination of individual teachers and tutors. 2020 saw the introduction of a new theme of learning for our first-year students: Professional Practice. This theme was developed to support student professional identity formation, and to make explicit the skills and practices required to be a good doctor that are needed alongside the biomedical knowledge and clinical skill that are already well-established components of the course. This presentation will share the story of making space for the arts in medical education.

Adrienne Provenzano:
Imagining Possibilities for 21st Century STEAM Education: Inclusive, Diverse, Equitable, and Accessible

Space exploration is a topic through which a wide variety of curriculum areas can be taught and explored. There are many tools to amplify educational opportunities for students and more work yet to be done. Creativity, collaboration, communication, and critical thinking are 21st century skills that can be developed through an inclusive, diverse, equitable, and accessible multidisciplinary approach to STEAM education in informal and formal educational settings.

Tuesday Afternoon Session 2 (15:15 to 16:45 AEDT | 00:15 to 01:45 EDT | 06:15 to 07:45 CEST)

Theme: *"Being human: exploring the intersection between health and culture"*

***Session Chair*: Annalea Beattie**

Presenters and panel participants:

Associate Professor Alice Gorman (College of the Humanities, Arts and Social Sciences, Flinders University): ***Gravity, memory and material culture***

On board the International Space Station, there are many aspects of material culture that replace Earth gravity in the free fall environment. These include hand and footholds on the walls to enable both movement and

stability, belts and bands to secure objects, Velcro dots and patches on clothes, walls and objects to allow a correspondingly velcroed object to be secured, and zip-lock plastic bags. These perform the function of preventing objects from floating away and becoming lost amid the chaotic interiors. In this paper, I argue that the material culture used to secure objects acts to augment aspects of memory which, on Earth, rely on gravity. This has implications for how space habitats are designed to facilitate crew comfort and efficiency.

Associate Professor Justin Walsh (Department of Art, Chapman University): ***Social considerations for long-duration spaceflight – the archaeological view***

The International Space Station Archaeological Project is concerned with understanding what life is like in "a microsociety in a miniworld" – the crew of the International Space Station – using the relationships between people, objects, and spaces as evidence. One of the goals of ISSAP is to provide insights that can be used to improve future space habitats, especially livability. In this presentation, we will examine some examples that show aspects of life in space that are not usually considered, not prioritized, or are afterthoughts for space station designers, but yet which still create impacts on health and well-being for crew. These examples include venues for self-expression through visual displays and provisions for privacy.

Dr Angelo Vermeulen (Delft University of Technology | SEADS):
Spreading Colonization and Culture War through Space: A Deconstruction

In his presentation, Angelo Vermeulen will talk about two recent space art projects that he developed with the international SEADS collective. Both art projects illustrate SEADS' interest in deconstructing mainstream space exploration narratives and articulating alternative pathways towards the future. Historically, colonization and agriculture have consistently worked hand in hand. However, in the unparalleled conditions of space, this ambiguous relationship is bound to take on new contours, with its own set of unique ideologies and ensuing ethical conflicts. The Space Farming Project explores these issues by crafting prototypes for space-based horticulture with communities of non-space experts. Ēngines of Ēternity is a multi-level art project that takes the biological phenomena of cloning and DNA repair as departure points for an artwork about humanity's obsession with cultural immortality. The project specifically zooms in on the cultural imaginary of space-based utopias. The project is a collaboration between SEADS and the biological laboratory of Prof. Karine Van Doninck at UNamur. In 2019 the first generation of the Ēngines of Ēternity artwork was launched to the International Space Station. Currently, the second generation of the artwork is under development and scheduled to be launched in November 2020.

Rabbi Dr Aviva Kipen (Spiritual Director | Victorian DHHS | NHMRC): ***Space and Spirituality***

When the Former Soviet Union launched Sputnik in 1957, the earthly cold war was propelled into a new dimension. Past wonderings about the possibilities of space had been the province of speculative science, and its creative cousin 'science fiction'. Space now became an achievable terrain for conquest, a potential landscape for the future proclamation of political and religious ideologies beyond Earth. Ever since, individuals in space have brought their spiritual traditions with them as they journeyed into what earthlings identified as the Heavens. How is the religious ecology of space to accommodate the faith diversities of its explorers and residents? Does space offer paradigms for a successful spiritual ecosystem which might avoid some of the Earthly upheavals of the past? God may or may not be providing this briefing!!

Dr Rowena Christiansen (University of Melbourne | the *ad astra vita* project | Mars Society Australia):
Human reproduction in the space environment – challenges and conundrums

The human family is the cornerstone of our social structures and cultural transmission. However, human reproduction in space is probably the last great taboo, and the "elephant in the room" that no-one wants to talk about… but talk about we must if we are serious about becoming an inter-planetary species with settlements on other celestial bodies. Limited research has been carried out to date with various invertebrate and vertebrate species, including mice and rats, but due to the lack of knowledge and the risks posed by space radiation, it is currently thought to be far too dangerous to experiment with human reproduction. Radiation is not the only physiological space insult to the reproductive system, and there is a really fundamental question as to whether we will still be the same race of humans in the space environment, or will we evolve and adapt as a natural evolutionary process? A key factor to consider is gravity… or the lack thereof. Questions exist as to the role of gravity in key reproductive processes and in-utero development, and what its absence or diminution will mean. Suitable medical care and infrastructure will also be needed for both women and children's health, and from a human rights perspective, the rights of the child also need to be considered in terms of exposure to dangerous extreme environments and the effects that this may potentially have on child development. Some people see a market opportunity for "space conception" as part of space tourism.

Tuesday Twilight Session (17:00 to 18:30 AEDT | 02:00 to 03:30 EDT | 08:00 to 09:30 CEST)

Theme: Human Factors | Theme: Space4Health

***Session Chair*: Vienna Tran**

Dr Ilaria Cinelli (President, Aerospace Human Factors Association | AsMA Councillor):
Enabling access to space through human factors requirements

Incoming human activities in outer space will include spaceflight participants and space tourists. Yet, it is unclear how to guarantee safety for any non-standard population. This talk will cover human factors requirements, classification and classes for enabling safe access to space and a robust cross-collaboration between space agencies and private partners.

Hussain Bokhari (Founder, Holistic Bodies | International Space University ISP 2020 Team Project): ***Using space-enabled capabilities for monitoring, mitigation and prevention of pandemics***

From the very beginning of humanity's activities in space, the population of the Earth has benefited from space exploration and applications that stem from it. Space-enabled capabilities have helped society in the fields of communications, Earth Observation, disaster mitigation, telemedicine, public health services, supply chain, IoT, and pandemic management. This mission was a three-part study that investigated: Monitoring, Mitigation, Prevention, and Preparedness. The objective was to conduct a study of existing policies, mechanisms, and practices in order to understand existing gaps in monitoring, prevention and preparedness, and mitigation of pandemics around the world. Next, the group introduced innovative suggestions about using space applications and technology to prevent the next pandemic from happening and to be better prepared to limit its impact if it does happen.

As a result of having done a thorough analysis of reports and findings from previous pandemics, we determined that using a combination of the following space-based technologies and applications would help us to improve efforts in preventing and preparing for future pandemics. These applications and technologies include, and are not limited to, satellite internet, constellations, Artificial Intelligence (AI) tools for creating disease risk maps, Global Navigation Satellite System (GNSS), Earth Observation (EO) data, and Unmanned Aerial Vehicles (UAV)s. The wide range of technologies available through space applications is divided into categories that have the greater potential to help with pandemic prevention, preparedness, monitoring, and mitigation. We discussed space as a critical infrastructure, current gaps in data processing and artificial intelligence with Earth Observation, remote healthcare provision, monitoring of populations to inform decision makers, and countering the impacts of pandemics on the supply chain. For example, Earth Observation data has provided valuable insights into the movements of cargo ships and aeroplanes, as well as the reduction in pollution resulting from the lockdown. The report also has made suggestions for national governments, international institutions, and businesses to further their efforts and support for advanced space and epidemiology research to develop vaccines and therapeutic medicines that can help prevent and better prepare us for future pandemics.

Dr Ali Nasseri (University of British Colombia | International Space University SSP 2014 Team Project):
Space4Health: Using space assets and disruptive innovations in support of public health during disasters (and beyond)

Space assets are a vital component of public health preparedness. Tele-medicine, pandemic monitoring, and remote sensing and satellite communication for disaster relief are just some examples of how space has been crucial in supporting public health initiatives. This talk will share outcomes of the Space4Health team project as part of the International Space University's 2014 Space Studies Program (SSP), and extensions to that work. In this project, a set of key space assets and disruptive innovations were identified that when put together can help support public health efforts.

To showcase the use of these technologies both in prevention and reaction to different public health scenarios, three concepts of operations will be presented based on these and similar technologies to:

- *Facilitate the operation and coordination of disaster relief efforts after a natural disaster*
- *Monitor emissions in fracking sites*
- *Enable medical autonomy in long duration space missions, or remote environments on Earth.*

Tuesday Evening Session (19:00 to 21:15 AEDT | 04:00 to 06:15 EDT | 10:00 to 12:15 CEST)

Theme: Space4Health | Theme: Looking to the Future…

Session Chair: **Dr Rowena Christiansen**

Dr Astrid-Christina Koch (Directorate-General for Defence Industry and Space, European Commission): ***Copernicus and COVID-19***

Copernicus is the European Union's Earth observation programme, which monitors our planet and its environment for the ultimate benefit of the citizens of Europe. It delivers data, information and services based on satellite Earth Observation data and in situ (non-space) data. The programme is funded, coordinated and managed by the European Commission in cooperation with partners such as ESA and EUMETSAT.

The Copernicus programme is served by a set of dedicated satellites (the Sentinel family) and contributing missions (existing commercial and public satellites). The Sentinel satellites are specifically designed to meet the needs of the Copernicus information services and their users. Since the launch of Sentinel-1A in 2014, the European Union has initiated a process to place a complete constellation of almost 20 satellites in orbit before 2030. Today, there are seven Sentinel satellites in orbit, of four different types.

Copernicus satellites, along with ground-based, airborne and seaborne measurement sensors, are providing vast amounts of global data. The Copernicus services transform the wealth of satellite and in situ data into timely and actionable information by processing and analysing it. The services deliver datasets and time series that are comparable and searchable, ensuring that trends and changes are monitored. Patterns are examined and used to create better forecasts of, for example, the ocean and the atmosphere. Maps are derived from imagery, features and anomalies are identified and statistical information is extracted. These value-adding activities are streamlined through six thematic streams of Copernicus services: the Copernicus Atmosphere Monitoring Service (CAMS), the Copernicus Marine Environment Monitoring Service (CMEMS), the Copernicus Land Monitoring Service (CLMS), the Copernicus Climate Change Service (C3S), the Copernicus Emergency Management Service (CEMS) and the Copernicus Security Service.

Dr Koch will discuss the Copernicus Atmosphere Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S) and how these services are being utilised to support the COVID-19 crisis. A CAMS COVID-19 mini-site has been developed, and CAMS currently contributes to a number of epidemiological studies trying to evaluate the links between air pollution and COVID-19 (effects of long- and short-term exposure; fine particulate matter as a potential vector in air for the virus?...). CAMS also showed that erroneous use of Sentinel-5P data led to thinking that effect of restriction measures on US air quality were earlier and stronger than in reality.

Recent research suggests that the spread of the new coronavirus (SARS-CoV-2) could be affected by temperature and humidity, so C3S has worked with environmental software experts B-Open to develop an application that maps mortalities against temperature and humidity data. The application allows health authorities and epidemiology centres to explore the claims that temperature and humidity could affect the spread of coronavirus.

Markus Woltran (UNOOSA): ***International cooperation on Space and Global Health***

UNOOSA: Space for Global Health

At the time of the global pandemic of COVID-19, as well as other challenges we face as humanity, the utilization of all available tools must be a priority. Throughout history, science, technology and innovation have proven their unmeasurable utility to society. The value of space programmes has manifested itself greatly during this pandemic. Contact tracing, disease modelling, transmission monitoring, understanding economic implications and impact of lockdowns on the environment, remote work, tele-health and communication for businesses, friends and families – these are all aspects where space plays a critical role.

*UNOOSA has taken a number of steps to improve its ability provide support in health emergencies. A dedicated **Task Force on Space for Health** was established to improve inter-office coordination in developing concrete responses to the novel needs, and in order to help bridge the information crisis, **UN-SPIDER compiled** examples of contributions and best practices in using space for addressing COVID-19.*

Space 4 Health webinar

*As an integral part of the overall effort to harness the power of space to tackle challenges of humanity by sharing new and existing space initiatives and best-practices, UNOOSA organized a **Space 4 Health webinar on 14 May 2020**. During two 90-minute sessions, experts from UNOOSA, international organizations, governments and private sector operating in the space sector discussed the role of space in early warning, risk reduction and management of epidemics and other health risks. Particular attention was paid to the current coronavirus pandemic. The webinar also covered what UNOOSA is doing to help UN Member States access the benefits of space for better health and integrate these tools in national policies and practices.*

The webinar had the following objectives:

- *Increase **awareness** about existing space applications for better health and best practices;*
- *Explore the **role of space** in disaster management, particularly for reducing the health impacts of disasters;*
- ***Foster synergies** among existing initiatives and practices;*
- ***Promote networking and** global **collaboration** on space for health.*

Ana Cristina Galhego Rose (Dipteron UG): ***Developing a Dengue Outbreak Prediction Model in a Smart City Platform***

The DIPTERON application detects Aedes mosquito risk areas based on Artificial Intelligence (AI) that combines satellite data and ground data, which allows decision makers to take mitigation actions for Dengue outbreaks.

Associate Professor Rachel Lowe (London School of Hygiene & Tropical Medicine):
Linking Earth observations to infectious disease decision support systems

Among extrinsic factors that might affect COVID-19 transmission dynamics, the potential influence of weather conditions and seasonality remain unclear. Respiratory viral infections often show seasonality, with influenza and other coronaviruses peaking in winter, yet the underlying mechanisms are poorly understood. As SARS-CoV-2 is a new virus to humans, it is difficult to ascertain if seasonal climate variations might enhance or reduce transmission in the first pandemic wave given the high proportion of susceptible people and the potential confounding role of different types of local containment measures adopted at different times after the onset of local outbreaks. In this talk, I will present a methodological approach to detect weather-dependent signatures in the transmission of a novel virus. Building on previous work incorporating climate forecasts and Earth observations into decision support frameworks for dengue and malaria, I will discuss the implications and challenges associated with using climate information to support the COVID-19 response.

Dr Angelo Vermeulen (Delft University of Technology | SEADS): ***Regenerative Synthetic Ecosystems and Evolving Asteroid Starships: Crafting Resilient Futures in Space***

E|A|S (Evolving Asteroid Starships) is a transdisciplinary research programme at Delft University of Technology, in collaboration with the international SEADS collective. A bio-inspired concept of an evolving spacecraft is being developed through a combination of design research, artistic research, systems engineering, mathematical modelling and computer simulation. The spacecraft is conceived to be an open and responsive life-like entity that is in constant dialogue with its internal and external environment. It achieves this by integrating robotic asteroid mining, space-based 3D manufacturing, architectural self-replication, and an onboard regenerative ecosystem. In his talk, Angelo Vermeulen will draw attention to the imperative of radical transdisciplinary thinking to design deeply resilient futures, both on Earth and in space.

Vienna Tran (Medical Student, University of Adelaide | Symposium Co-Host):
Summation of Symposium proceedings

Activity: Collective word cloud from participants

Dr Rowena Christiansen (Symposium Convenor): ***Thanks and conclusion***