About the Authors

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Editors – Gregory E. Chamitoff and Srinivas Rao Vadali

Gregory E. Chamitoff



Originally from Montreal, Canada, Greg Chamitoff served as a NASA Astronaut for 15 years, including Shuttle Missions STS-124,126,134 and Space Station long duration missions Expedition 17 and 18. He lived and worked in Space for almost 200 days as a Flight Engineer, Science Officer, and Mission Specialist. His last mission was on the final flight of Space Shuttle Endeavour, during which he performed two spacewalks, including the last one of the Shuttle era which also completed the assembly of the International Space Station.

Chamitoff earned his B.S. in Electrical Engineering from Cal Poly, M.S. in Aeronautics from Caltech, and Ph.D. in Aeronautics and Astronautics from MIT. He also holds a minor and a Masters in Planetary (Space) Science. Prior to selection by the NASA Astronaut Program in 1998, Chamitoff worked at Four Phase Systems, Atari Computers, Northern Telecom, IBM and Draper Laboratory. As a Draper Fellow, he worked on several NASA projects, including the Hubble Space Telescope, the Space Shuttle autopilot, and the attitude control system for Space Station Freedom. He was a visiting lecturer at the University of Sydney, Australia, before joining Mission Operations at the Johnson Space Center, where he worked on attitude control and maneuver optimization for the International Space Station (ISS). He is an author of NASA's first technology memo on resource utilization on Mars, and worked on various projects related to Mars mission design. As an astronaut, he has been Lead CAPCOM in Mission Control, and supported ongoing missions in numerous other roles. In 2002, Chamitoff was a crewmember on the NEEMO-3 Mission (NASA Extreme Environment Mission Operations), living and working on the Aquarius undersea research habitat for 9 days.

Chamitoff is the Zachry Professor of Practice in Aerospace Engineering, and Director of the AeroSpace Technology Research & Operations (ASTRO) Laboratory at Texas A&M University. His research includes space robotics, autonomous systems, and the development of collaborative VR simulation environments for space system engineering and mission design.

Srinivas Rao Vadali



Srinivas R Vadali is Professor and Interim Department Head of Aerospace Engineering at Texas A&M University. He received his PhD from Virginia Tech in 1983 and has more than 30 years of academic teaching and research experience. He has made significant contributions in the areas of satellite attitude control and orbital mechanics. He has authored or co-authored 66 articles in highly respected peer-reviewed aerospace journals and has been funded extensively by the Air Force and NASA. His h-index is 38 and his/her papers have been sited more than 5295 times. He is a co-author of the book Spacecraft Formation Flying: Dynamics, Control and Navigation. He has served as Associate Editor of the AIAA Journal of Guidance, Control, and Dynamics and the International Journal of Aerospace Engineering. He is a Fellow of the AAS and an AIAA Associate Fellow. He has received the AIAA Mechanics and Control of Flight Award and the AAS Dirk Brouwer Award. He has served as Vice President Technical for the American Astronautical Society and Associate Director for Texas Space Grant Consortium.

Foreword – Bonnie J. Dunbar



Bonnie Dunbar is a retired NASA astronaut, engineer and educator, currently with Texas A&M University as the John & Bea Slattery Chair Professor in the Department of Aerospace Engineering. She also has a joint appointment as the Director of the TEES Institute for Engineering Education and Innovation (IEEI). Dunbar, who is a member of the National Academy of Engineering, came to Texas A&M from the University of Houston where she was an M.D. Anderson Professor of Mechanical Engineering. There she provided leadership in the development of a new integrated university science, technology, engineering and mathematics (STEM) center and was Director of the Science and Engineering Fair

of Houston. She also directed the SICSA Space Architecture and Aerospace graduate programs.

Dunbar worked for The Rockwell International Space Division Company building Space Shuttle Columbia and worked for 27 years at NASA, first as a flight controller; then as a mission specialist astronaut, where she flew five space shuttle flights, logging more than 50 days in space. She then served for 7 years as a member of the NASA Senior Executive Service (SES). Her executive service included assistant NASA JSC director for university research; deputy director for Flight Crew Operations; Associate Director for ISS Mission Operations development, and as NASA headquarters deputy associate administrator for the Office of Life and Microgravity Sciences and Applications (OLMSA). She also served as part of the Challenger Space Shuttle accident investigation team. After retiring from NASA, Dunbar became president and CEO of The Museum of Flight in Seattle, where she established a new Space Gallery and expanded its K12 STEM educational offerings.

Dunbar holds bachelor and master degrees in ceramic engineering from the University of Washington and a Ph.D. in mechanical/biomedical engineering from the University of Houston. She is a Fellow of the American Ceramic Society, the American Institute of Aeronautics and Astronautics, and the Royal Aeronautical Society. She has been awarded the NASA Space Flight Medal five times, the NASA Exceptional Leadership Medal and the NASA Distinguished Service Medal. Dunbar was inducted into the Royal Society of Edinburgh, and, in 2002 was elected to the US National Academy of Engineering. In 2013 she was selected into the Astronaut Hall of Fame, in 2016 she was inducted into the Omega Alpha Association (OAA) Systems Engineering Honor Society, and in 2017 Dr. Dunbar was elected as the President of the Association of Space Explorers (ASE).

Introduction – Gerry Griffin



Gerry was a Flight Director ("Gold Flight") in Mission Control for every Apollo Program manned missions. Gerry was the Lead Flight Director for Apollo 12, Apollo 15 and Apollo 17. He and his "Gold" team conducted half of the lunar landings made during Apollo: Apollo's 14, 16, & 17. Gerry's team was scheduled to conduct the landing of Apollo 13, and when the landing was canceled as a result of an oxygen tank explosion his team played a key role in the safe return of the astronauts.

After the Apollo Program, Gerry served as the Deputy Director of the Hugh F. Dryden (now Neil A. Armstrong) Flight Research Center and as Deputy Director of the John F. Kennedy Space Center before being named Director of the Lyndon B. Johnson Space Center. Gerry also held the posts of Assistant Administrator for Legislative Affairs, Associate Administrator for External Relations, and Deputy Associate Administrator for Space Flight (Operations), all at NASA Headquarters in Washington DC.

Gerry earned a Bachelor of Science degree in Aeronautical Engineering from Texas A&M University and was commissioned as an officer in the U.S. Air Force. After serving four years on active duty and three years in the private sector he joined NASA as a flight controller in Mission Control, specializing in guidance, navigation and control systems for Project Gemini and the early unmanned missions of the Apollo. Gerry was selected to be a Flight Director before the first manned Apollo mission, Apollo 7.

Gerry received numerous awards during his years with NASA including the Presidential Medal of Freedom awarded to the Apollo 13 Mission Operations Team, the NASA Distinguished Service Medal, the NASA Outstanding Leadership Medal, and two NASA Exceptional Service Medals. Gerry is a Fellow of the American Institute of Aeronautics and Astronautics and the American Astronautical Society. Today Gerry is a technical and management consultant for a broad range of clients in the private sector.

Chapter 2. Mission Integration and Execution – Edward A. Van Cise



Ed Van Cise is a 2000 graduate of the University of Michigan with a bachelor's degree in Aerospace Engineering. Ed has been working in ISS operations at the NASA Johnson Space Center since 1998 when he was a co-operative education student. He first started as an Operations Support Officer (OSO) flight controller, which oversees the Structures & Mechanisms as well as In-Flight Maintenance of the ISS. In this work, Ed instructed flight controllers and astronauts in various maintenance lessons and worked a number of ISS assembly missions. Ed was also certified at the TITAN console position, which was responsible for the ISS Motion Control, Command and Data Handling, and Communications systems. He was selected as a NASA Flight Director in 2009, certified in January 2010, and became the 78th NASA Flight Director,

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taking the call sign "Carbon Flight." All totaled, Ed has over 8,100 hours of console experience in ISS operations.

Ed has accumulated over 90 minutes of zero gravity experience on NASA's Vomit Comet aircraft and has utilized his SCUBA certification to dive on the full-size ISS mockups in NASA's Neutral Buoyancy Laboratory. The US Space and Rocket Center's Space Camp was a major influence on his career planning and in Summer 2012, he was inducted into the US Space Camp Hall of Fame. A native of Bay City, Michigan, Ed is married and has two children.

Chapter 3. Mission Engineering – George H. James, III



George James obtained a PhD in Aerospace Engineering (Dynamics and Control) and an M.S. in Aerospace Engineering (Mechanics of Materials) from Texas A&M University. He also has an M.S. in Physical Science (Planetary Science) from the University of Houston at Clear lake, and a B.S. in Physics from Angelo State University. George is currently an Aerospace Engineer at NASA Johnson Space Center with experience in the Loads and Structural Dynamics Branch of the Structural Engineering Division as well as the Program Technical Integration Branch of the Project Management and Systems Engineering Division. While with NASA, he has worked with the Commercial Crew Program (Loads and Technical Integration teams), NASA Orion Development (Loads and Dynamic Environments team), the Space Shuttle (Technical Manager for Loads and Structural Dynamics), and the International Space Station (Structures and Mechanisms team). His previous positions included: self-employed performing structural dynamics data analysis development, Shuttle mission support, and Martian resource utilization; visiting professor with the Aerospace Engineering Science Department at the University of Colorado Boulder; post-doctoral researcher (Structural Health Monitoring) in Mechanical Engineering Department at the University of Houston; member of technical staff in the Experimental Structural Dynamics group at Sandia National Laboratories; and graduate researcher in Aerospace Engineering at Texas A&M University. These activities have allowed him to work with spacecraft engineering integration, major system level tests of space systems, pre-flight operations, on-console support during the launch countdown phase, and in the Mission Evaluation Room (MER) during joint ISS/Shuttle operations. His technical work has included engineering technical integration; loads, structural dynamics, and acoustics environment development for manned space vehicles; development of operational modal analysis techniques; system-level structural and environmental test planning and support; structural health monitoring development; mass properties measurement; high-temperature materials testing; and planetary landing optimization.

Chapter 4. Space-Based Power Systems – Scott Simmons



Scott Simmons currently works for KBR at NASA Johnson Space Center (JSC) in Houston, Texas. He began working on the International Space Station (ISS) program with United Space Alliance at JSC in 1997. He is currently a senior instructor in the Flight Operations Division responsible for training crew and flight controllers to operate and respond to failures of the International Space Station (ISS) Electrical Power System and External Thermal Control Systems. Scott trained the ISS Expedition 1 crew as well as STS-97 Shuttle crew and flight control team that delivered and activated the first power channels to ISS. Since then, Scott trained and certified numerous space station crews and flight controllers to support the ongoing operation of the ISS power system. He held a flight control POWER certification and supported multiple shuttle assembly missions from Mission Control. Scott also directly supports the ongoing integration and coordination of ISS core system crew training across all International Partners. He is a Space Flight Awareness honoree as well as recipient of two Silver Snoopy awards presented by the astronaut corps for outstanding service. Scott has a bachelor's degree of science in Physics, Mississippi State University, 1991.

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Chapter 5. Environmental Control and Life Support Systems – John Garr and Barry Tobias

John Garr, II



John is an Honors Program graduate from Tennessee Tech University holding BS (magna cum laude) and MS degrees in Mechanical Engineering. He also holds a MS in Environmental Engineering from the University of Alabama in Huntsville. He began working for NASA in 1992 at the Marshall Space Flight Center as an integrated life support systems analyst before transitioning to test support and project engineering. During this time, John performed bench tests and modelling of International Space Station (ISS) regenerative life support hardware subsequently launched to ISS. John later spent a year verifying and validating ISS life support and thermal flight software.

In 1996, John moved to the Johnson Space Center to become one of the first certified Environmental Control and Life Support Systems (ECLSS) flight controllers. He served as the lead ECLSS flight controller for 7 separate ISS/Space Shuttle Assembly missions, including all missions delivering US life support hardware. John worked 19 assembly missions, spanning the first module delivery in 1998 to the final Shuttle mission in 2011. John played an integral part of delivery and activation of the oxygen generation, water processor, urine processor, and CO_2 reduction assembles. He was lead for 6 ISS Expedition Crews and supported console for all 50 ISS crews. John recertified as an Environmental and Thermal Operating Systems (ETHOS), which expanded ECLSS to include control responsibility for the internal thermal control systems. He has ~10,000 hours of direct Mission Control Center console support.

John helped train and certify every life support flight controller in the past 20 years of ISS operations, and coauthored conference papers on life support operations. He has been recognized four times to hang the mission plaque as the most outstanding flight controller, has received 3 NASA Space Flight Awareness team awards, and was honored with the Astronaut Silver Snoopy Award from the 2J/A STS-127 Shuttle commander. John was awarded the NASA Exceptional Service Medal for his outstanding career service to the NASA human spaceflight mission.

Barry Tobias



Barry earned his BS and MS in Mechanical Engineering at Washington University in St. Louis, graduating magna cum laude and as a member of the Pi Tau Sigma Honor Society. During his time there, Barry was active in the Wash U chapter of AIAA and helped develop the predecessor to the Aerospace Systems Lab. As the student leader of this lab, he found his way into being a member of Steve Fossett's 2002 Budlight Spirit of Freedom Round-the-World balloon flight, acting as Mr. Fossett's Assistant Air Traffic Control Coordinator as well as being in charge of setting up and maintaining the Mission Control Center at Washington University. After graduating in 2003, Barry joined United Space Alliance as an ECLSS flight controller, transferring to NASA in 2010. As an ECLSS, he worked over 4,500 hours on console during 29 Station Increments and 11 Shuttle flights. His specialty within the group was Emergency Response Strategy, Water Systems, and Regenerative Life Support Systems. Barry performed a 6-month rotation as the Spaceflight Systems Division Integration Technical Assistant, after which he transitioned into the Orion EECOM flight control team. Barry has provided Orion vehicle and ConOps design inputs from the operations perspective. Barry was named lead EECOM for the Artemis I unmanned test flight. Barry was born in Cape Town, South Africa, but grew up in Birmingham, AL, which he considers his home town.

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Chapter 6. Command, Control and Communications – Dan Jackson



Dan's career started in radio communications, teaching microwave radio and digital multiplexing techniques for the US Air Force. He earned his degree at Auburn University and went on to earn a commission as a Second Lieutenant. Dan was assigned to the Defense Support Program (DSP) wherein he acquired skills in the remote detection of enemy ICBM launches. While supporting Desert Storm, the DSP team tuned a satellite and a satellite ground station to enable the detection of SCUD missiles launched from the hot Iraqi backdrop. The team was credited with saving countless American lives. Before leaving the Air Force, he integrated university science projects into the Space Shuttle mid-deck lockers and ultimately joined the Space Station program as a civilian contractor. Dan earned flight control certifications as a Station Duty Officer, a Communications and Tracking officer and then earned a multi-systems certification as a Telemetry, Information, Transfer, and Attitude Navigation (TITAN) flight controller, ultimately serving more than 7800 hours at Space Station consoles. As a Senior Technical Fellow, Dan supports the communications and command and control discipline, CRONUS, where he creates console tools that empower flight controllers to simplify and automate flight control processes. In his spare time, Dan writes all manner of fiction stories, having managed to publish one book. He is the recipient of numerous awards, including the Excellence in Engineering Medal from NASA, multiple Spaceflight Awareness Awards from NASA, US Air Force Meritorious Service Medal, three Air Force Commendation Medals and an Air Force Achievement Medal for actions supporting Desert Storm. He has a bachelor's of science degree in Aerospace Engineering, Auburn University, 1986. Dan was born in Monroe, Louisiana. He is married to Lisa Jackson and has four children and ten grandchildren.

Chapter 7. Thermal Control Systems – Anthony Vareha



Anthony Vareha is a NASA Flight Director with over 6000 hours of on-console experience as an International Space Station flight controller. He served as an ISS systems flight controller from 2007 until 2015, first as a THOR (Thermal Operations and Resources) officer and then as a SPARTAN (Station Power, ARticulation, Lighting and Analysis) officer. In 2011, he served as ISS thermal systems lead for the planning and execution of the STS-134 Space Shuttle mission. He had the opportunity to lead the SPARTAN response to a number of critical ISS failures, including the loss of 3 power channels in mid-2012, a small ammonia leak in late 2012, a very large ammonia leak in May of 2013, and the recovery of a failed ammonia pump in late 2013. As a NASA Flight Director, he was lead for ISS Expedition 61 as well as Crew-1, the first commercial crew rotation mission. He is a 2006 graduate of Embry-Riddle Aeronautical University with a degree in Engineering Physics, and in 2014 received his master's degree in Systems Engineering from the University of Houston at Clear Lake.

Chapter 8. Trajectory Design and Operations – Aaron Brown



Aaron Brown attended Space Camp in Huntsville, AL four times as a teenager. And the rest is history. He has a Bachelor's degree from the University of Illinois, a Master's degree from the University of Texas at Austin (UT Austin), and is working on a Ph.D. through UT Austin, all in Aerospace Engineering. Aaron began work at the NASA Johnson Space Center (JSC) in the Fall of 2000. He started in the International Space Station (ISS) Trajectory Operations group, became certified as an ISS Trajectory Analyst (TA), and then as a full Trajectory Operations and Planning Officer (TOPO) in 2004. Aaron supported the STS-115 mission in the Fall of 2006. At the end of 2006, he transitioned out of the TOPO group and began conducting trajectory analysis work for several beyond Low-Earth

Orbit (LEO) programs, including NASA's Constellation and Orion Programs. In recent years, Aaron has developed trajectory software tools to analyze and support the ISS mission, Orion's Exploration Flight Test 1 (EFT-1) mission, and Orion's Artemis 1 & 2 missions. Aaron currently supports development of Orion's onboard Guidance, Navigation, and Control (GNC) system. Coupling this experience with his background in trajectory operations, Aaron has come to better appreciate the complexities in developing and operating a spacecraft.

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Chapter 9. Guidance, Navigation, Control and Propulsion – Kenneth Longacre, John Osborn-Hoff, and Aaron Brown

Kenneth Longacre



Ken Longacre is an expert in Guidance Navigation and Control System Operations, and has spent 20 years in the aerospace industry. He has logged thousands of hours on console in the Mission Control Center supporting both the ISS, and Shuttle Programs. While continuing to serve as an as an International Space Station Attitude Determination and Control Officer (ADCO) Flight Controller, Mr. Longacre has been working on the Space Launch System Program and with ULA, Boeing and SpaceX on the Commercial Crew Program, working to get these new vehicles off the drawing board and flying in space.

Mr. Longacre has received numerous awards for his work in Mission Control including the NASA Exception Service medal for technical leadership in GNC flight operations contributing to the design and operational efficiency of multiple human space flight programs and a Silver Snoopy in 2012 for his work developing the operational products to support the first ever Optimal Propellant Maneuver on the ISS.

He served as the Increment 42 Lead ADCO as well as the Lead ADCO for the Orbital-2 ISS commercial resupply mission in 2014. Prior to his time flying the ISS, Mr. Longacre served a Space Shuttle Guidance, Navigation and Control Flight Controller. As a Shuttle GNC Flight Controller he worked in the Mission Control Center for 15 Space Shuttle Missions, and was Lead GNC for STS-127/2JA and STS-132/ULF4. Mr. Longacre began his career with NASA as a software engineer responsible developing simulation software used for Space Shuttle Ascent and Entry preflight and realtime trajectory design. Prior to his NASA experience, he worked for Hughes Training, developing Crew Training Simulators for C-130 and F-16 aircraft. Over the course of his career, Mr. Longacre has earned the following Flight Controller Certifications: ADCO Specialist, ADCO Operator, Orbit GNC, GNC Support, Ascent/Entry Sensors, Abort Region Determinator (ARD) Support Officer, Trajectory Applications Officer.

John Osborn-Hoff



John Osborn-Hoff spent 18 years working for NASA in manned spaceflight operations and new vehicle development. As a Space Shuttle flight controller, he specialized in payload operations including the Hubble Space Telescope and SpaceHab pressurized modules. He was also responsible for operations associated with installation and activation of new ISS modules including the S1 and P1 truss segments. He was also assigned to provide operations and design insight into numerous spacecraft development projects including Space Launch Initiative, Orbital Space Plane, Orion, Ares-1, Space Launch System, SpaceX Dragon, and Boeing Starliner. After the STS-107 Columbia accident, Mr. Osborn-Hoff served as the NASA lead for a multi-agency debris recovery team and subsequently served several times as the mission lead for the Shuttle's Wing Leading Edge Impact Detection System. He is a certificated NASA Instructor. Most recently, as a member of the Exploration Vehicle Guidance Navigation and Control Group, he served as the Flight Operations Directorate lead for both the development of the SLS Exploration Upper Stage and for spacecraft manual control.

Mr. Osborn-Hoff left NASA in 2017 to complete a Ph.D. in Mechanical Engineering with research focusing on designing manned spacecraft to yield satisfactory handling qualities.

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Chapter 10. Extravehicular Activity – Zebulon Scoville, Anna Jarvis, and T. Jordan Lindsey

Zebulon Scoville



Zeb holds a BS in Mechanical Engineering and an MS Aero/Astro Engineering from Stanford University. He currently serves as a Flight Director in the Flight Operations Directorate at the Johnson Space Center. In this role he has led several Extra-Vehicular Activities (EVAs) and is currently the lead Flight Director for Artemis exploration EVA operations. He was the lead Flight Director for the SpaceX Demo-2 crewed test flight, as well as multiple cargo resupply missions. He was also lead for emergency operations on ISS. Previously, Zeb was the Lead for the EVA Task Group. In that role he was responsible for all operational, technical, and personnel aspects of the EVA Task Group. During his time in this role, 34 spacewalks were executed which completed the assembly phase of ISS, and restored critical ISS system functionality after several malfunctions.

Zeb led development of the initial EVA feasibility study for the Asteroid Redirect Crewed Mission (ARCM), and the EVA operations lead for multiple desert and underwater analog missions. In early roles, Zeb served as a Flight Controller and Trainer for the EVA Systems and Task Groups. He has supported 16 Shuttle and numerous ISS increment missions and was the Lead EVA Officer for STS-123, STS-128, and STS-131. After the Columbia accident, he helped develop Space Shuttle Thermal Protection System (TPS) inspection and repair techniques in support of the Return to Flight effort. His background includes aviation experience as a Pilot/Mission Scanner for the Civil Air Patrol and service as an Aviation Operations Officer, US Coast Guard Auxiliary.

Anna Jarvis



Anna Jarvis is a specialist in Extravehicular Activities (EVAs) with over 20 years of expertise in Space Shuttle and International Space Station (ISS) operations. Upon graduating summa cum laude from Florida Institute of Technology in 1996 with a B.S. in Aerospace Engineering, Ms. Jarvis joined the NASA team as a contractor in Mission Operations. During her career as a Flight Controller and Instructor, Ms. Jarvis supported numerous Shuttle missions and was instrumental in the initial development of hardware and operational strategies for the ISS Joint Airlock. She was the lead EVA officer for the deployment of the European Space Agency's Columbus Module, as well as several other ISS maintenance EVAs. Ms. Jarvis is a certified Blackbelt in Lean Six Sigma process improvement principles with an extensive background in team leadership as a contractor manager and NASA Group Lead in EVA operations at the Johnson Space Center. Anna's contributions to human spaceflight have been recognized through several awards, including a Mission Plaque Hanging, a Silver Snoopy, and the Rotary NASA Stellar Award. Born and raised in northern Michigan, she currently resides in Friendswood, Texas with her husband and three children.

T. Jordan Lindsey



Jordan Lindsey has been working in Manned Space Flight Operations for 13 years. In his early career he served as a Non-Destructive Evaluation (NDE) Engineer at Cape Canaveral. As part of the NDE engineering group, he utilized ultrasonic techniques to inspect the Main Propulsion System (MPS) and avionics bay cold plates of the Space Shuttle. In addition to his MPS assignments, he was also certified to perform Infrared (IR) inspections of the wing leading edge Reinforced Carbon Composite (RCC) tiles post the Columbia accident. After working at Cape Canaveral for 1 year, he transferred to Houston to work as a flight controller with the Space Station Robotic Manipulator System (SSRMS). He was part of the robotics flight control group within the Flight Operations Directorate (FOD) for 3 years.

During that time. he was certified for the Mobile Base Subsystem (MSS) Task. Jordan developed the SSRMS trajectories for STS-120, STS-126, Expedition 16 ground control operations, and the first ground control of the Special Purpose Dexterous Manipulator (SPDM). He then transferred to the Extravehicular Activity (EVA) group, and has been supporting EVA operations for 9 years. Jordan was a certified EVA Officer and has been the EVA lead for ISS expeditions. As the EVA Skills Lead, he instructed new Astronaut Candidates and veteran Astronauts on EVA skills. Jordan currently works on the development of the new Exploration EMU for the Artemis program. Jordan lives in Houston with his daughter, Audrey and wife, Stacy. Jordan holds a Bachelor of Science in Physics (2002) from Western Kentucky University, and a Master's in Aerospace Engineering (2004) from the University of Cincinnati.

Chapter 11. Space Robotics – Megan Levins and Srinivas Rao Vadali

Megan Levins



Megan Levins is a graduate from the University of Nevada, Reno with a Bachelor's in Physics. Raised in Kona, Hawaii she now resides in Pearland Texas with her husband and two children.

Mrs. Levins has been at NASA Johnson Space Center since 2007. She currently oversees all Flight Controller and Astronaut training as a Chief Training Officer (CTO). She was the lead CTO for the upcoming SpaceX Dragon-11 cargo mission, preparing the NASA and SpaceX Flight Control teams for the mission. She was also the lead ISS CTO for the SpaceX Demo-1 and Demo-2 missions which launched NASA Astronauts to the ISS aboard a commercial vehicle. She is the Chair of the Expedition Training Requirements Integration Panel which oversees all Crew training plans.

She started her career as a Robotics Instructor and Flight Controller in the Robotic Operations group. As an instructor, Mrs. Levins was the lead for numerous missions including the first Vehicle to be captured by the Space Station Robotic Manipulator, and the only yearlong mission. As a Flight Controller she has supported operations for all of the Canadian built robotic systems, the Space Station Remote Manipulator System (SSRMS), Special Purpose Dexterous Manipulator (SPDM), and the Mobile Transporter (MT). She is also active in crew on-board training and received the NASA Silver Achievement Medal in 2013 for her leadership in the implementation of ground commanding for the setup and initialization of the Robotics On-Board Trainer (ROBoT), saving valuable crew time and resources.

Chapter 12. Science and Payload Operations – Eric Melkerson



Eric Melkerson is a graduate of the University of Notre Dame with a degree in Mechanical Engineering, and a MBA from Loyola University, Chicago. He has over 25 years of experience working on the International Space Station (ISS) program both at the Mission Control Center at the Johnson Space Center (JSC) and the Payloads Operations Integration Center at the Marshall Space Flight Center (MSFC). At JSC he developed operational concepts and flight products for the Motion Control System, culminating in the manning of the Attitude Determination and Control Officer (ADCO) Console. He then served five years as a Payload Operations Director (POD) responsible for the MSFC Flight Control Team executing NASA payloads. In 2005, Mr. Melkerson was named Chief of the Training and Crew Operations Branch, responsible for developing the procedures and training used by flight controllers and Astronauts in the execution of NASA science, research, and commercial payloads. In 2015 he was named Associate Director of the Mission Operations Laboratory. In 2016 he was selected to lead procurement activities resulting in the award of the Engineering Service and Science Capability Augmentation Contract for the Marshall Space Flight Center. He is currently Chief of the Project Engineering Branch of the Space Systems Department. In this role he manages Lead Systems Engineers supporting projects as diverse as Space Launch System Secondary Payloads, the Imaging X-Ray Polarimetry Explorer (IXPE) telescope, Lander initiatives and ISS payloads.

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Chapter 13. Spaceflight Medical Operations – Joseph P. Dervay, Keith E. Brandt, and Robert Sanders

Joseph P. Dervay



Dr. Joe Dervay is a Flight Surgeon at the NASA Johnson Space Center, having served there over 25 years. He completed undergraduate studies at Cornell University, and received his Doctor of Medicine from Syracuse—Upstate Medical Center. He completed a General Surgery Internship at the Bethesda Naval Medical Center. After training at Naval Air Station Pensacola, FL to become a Navy Flight Surgeon, he served aboard the aircraft carrier *USS John F. Kennedy*. Dr. Dervay completed an Emergency Medicine Residency in Washington, DC at The George Washington University. He subsequently practiced Emergency Medicine and concurrently worked in the Operational Medicine Office of Lockheed Engineering & Sciences Company, in direct support of NASA Headquarters.

Dr. Dervay relocated to Texas upon selection to the NASA/University of Texas Medical Branch at Galveston—Space Medicine Fellowship. The two-year pro- gram focused on operational space medicine and biomedical research. He earned a Master of Medical Sciences degree, with research on "Nitrogen Bubble Nucleation during Altitude Decompression". Additional training included a Residency in Aerospace Medicine, Master of Public Health degree, and training in Undersea & Hyperbaric Medicine.

Dr. Dervay has served as a Crew Surgeon for multiple Space Shuttle and long-duration International Space Station missions, including the NASA/SpaceX Demo-2 test flight. His roles included work in Russia at the Star City - Cosmonaut training center, and support of U.S. Astronauts during Soyuz launch and landing activities in Kazakhstan. Within Medical Operations, he has served as EVA Lead, Group Lead, and Commercial Crew Program Lead. He Co-Chairs the Multilateral Medical Operations Panel, comprised of medical experts from the Canadian, European, Japanese, and Russian space agencies. A U.S. Navy CAPTAIN, he completed 35 years of Active and Reserve service with numerous Navy and Marine Corps units worldwide.

Keith E. Brandt



Keith Brandt obtained his Doctor of Medicine degree at the Indiana University School of Medicine and trained at Community Hospitals of Indianapolis Family Practice residency. After completion of residency, he joined the United States Air Force as an operational Flight Surgeon. He graduated from the USAF Residency in Aerospace Medicine in 2000 and held Chief of Aerospace Medicine positions at US and deployed locations. He was the Air Force liaison to NASA supporting Space Shuttle and International Space Station missions. He completed his Air Force career as a faculty member of the USAF School of Aerospace Medicine and following military retirement, he joined the Johnson Space Center Operational Flight Medicine team supporting current and future crewed space missions.

Robert Sanders



Robert Sanders' medical "career" began in 1989 as an EMT & Ski Patrol member, and in 1993 he ventured into hyperbarics as a technician and supervisor at the USC Catalina Hyperbaric Chamber. He also served as a scientific diver and field safety officer in Antarctica for 4 seasons diving in 28° water below 12' of ice.

Needing to learn more, Sanders received his MD degree from the Chicago Medical School. After residency in Emergency Medicine at the University of Pittsburgh, and additional training at the University of Hawaii's Hyperbaric Treatment Center, he became boarded in both Emergency Medicine and Undersea & Hyperbaric Medicine.

Currently, Sanders is a Crew Health and Safety Flight Surgeon at the University of Texas Medical Branch and KBR on contract to NASA's NBL as their Medical Director. He has been the Medical Director for American Hyperbaric Centers in Anchorage AK (overseeing clinical hyperbarics & commercial dive operations), and an Attending Emergency Physician. He has also served as a Flight Physician for STAT MedEvac.

Sanders also serves as the tactical medicine physician for the Harris County Sheriff's Office Dive Team, after many years diving with the LA County Sheriff conducting search and recovery of bodies and evidence. He is an avid technical and scientific diver; has conducted shark diving & tagging operations, and worked as a set medic and water safety coordinator for the Motion Picture Industry. In 2017 Sanders was awarded NASA's prestigious "Early Career Public Achievement Medal".

Chapter 14. Mission Planning – Alex Moore



Alex Moore, Class of '96, currently lives in Pearland, Texas and is married to Melissa, also an Aggie Class of '00, and they have five children. Mr. Moore began working at JSC in 1997 and has been a Civil Servant since 2004 working for NASA and is currently the ISS Test & Verification Lead for SpaceX Commercial Crew and Cargo Visiting Vehicles. Mr. Moore graduated from Texas A&M in 1997 with a Bachelor's of Science in Aerospace Engineering and upon graduation began working for United Space Alliance at JSC in the Mission Operations Directorate before being hired by NASA. Mr. Moore was a certified member of the Operations Planning team from 1997 until 2014 and served as Group Lead for Mission Operations Planning from 2006 until 2014. Through his career Mr. Moore has had the distinct opportunity to support all three phases of International Space Station Operations in the Phase I NASA\Mir program, Phase II of Station assembly and Phase III of Station assembly complete. Mr. Moore was certified in several backroom Operations Planning positions including a Shuttle planning position. As Mr. Moore advanced through the mission planning certifications, he successfully obtained the Operations Planning Flight Control Room certification in 1999. Since that time, Mr. Moore had the opportunity to support ISS operations as a certified flight controller continuously starting with Increment 0 through Increment 42. During that time, Mr. Moore was the lead Operations Planner for 2A.2b and 13A.1 missions and Increment 10. In addition, Mr. Moore has had the opportunity to support several analog missions as a planner including NEEMO 9, 10, 11, 12 and 13.

Chapter 15. Mission Safety – David Witwer



While earning his Aerospace Engineering degree at Texas A&M University, David Witwer worked at the Oran Nicks Low Speed Wind Tunnel as part of the co-operative education program and obtained his FAA private pilot single engine land and private glider certificates. Upon graduation, David became a government contractor working at NASA's Johnson Space Center. Witwer spent the early years of his NASA tenure assigned as a safety representative to working groups supporting the Space Shuttle Program. He was responsible for evaluating flight operations associated with the descent phase of Shuttle operations, upkeep of crew procedure checklists, changes to flight rules and engineering studies at the NASA Ames Vertical Motion Simulator. Witwer also worked in Mission Control as a Safety Console Engineer in the Mission Evaluation Room for 50 of the Space Shuttles' 135 missions. On numerous occasions, this group would apply its problem-solving skills to help shuttle astronauts and other flight controllers make the necessary adjustments to ensure successful missions. David also worked on the Shuttle cockpit avionics upgrade to glass displays as well as the Orion Cockpit Working Group, which conducted research to recommend the best hand controllers, ideal number of displays, appropriate labels, and development of the crew alerting system. While working at NASA, David obtained his FAA commercial pilot and flight instructor certificates and became an airline pilot at Continental Express. David is currently a husband and father, a pilot for United Airlines, and resides in Clear Lake, Texas.

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Chapter 16. Vehicle Processing and Launch Operations – Mike Parrish and Kenneth Koby

Mike Parrish



Mike Parrish lives in Orlando Florida with his wife Debbie Parrish. They have been married for 39 years and have a son, daughter, and three grandsons. Mike began working at the Kennedy Space Center in June of 1979 after spending 4 years in the USAF. He started his space shuttle career as an electrical technician in the cargo bay working mechanical systems as well.

Mike was a certified spacecraft operator on STS-3 and became the first member of the astronaut exchange crew starting with STS-4. He was also the training instructor for spacecraft operators and a Crew module and thermal protection supervisor. Post Challenger, Mike was the crew module Operations lead for return to flight. He continued the duties in operations as a Site Test Conductor and then became the Operations Chief of Endeavor for the last 11 years of space shuttle processing. Mike currently works for Jacobs/ERC at the Kennedy Space Center as an engineering project manager and has worked on Crawler modifications, 50 MHZ Doppler wind profiler, and is working the operations concepts for EM-1 at the Multi Payload Processing Facility. Mike is currently overseeing the validation process at the MPPF to bring all the critical systems required on line, to fuel the Orion capsule with the required commodities for flight.

Unique Assignments: Member of the first Kennedy Space Center Human Factors team working with the Chief Engineers.

In his free time Mike enjoys water skiing, moto-cross, and scuba diving. Mike was given the name Captain Fun by members of the astronaut office.

Kenneth Koby



Ken is a Senior Quality Engineer for the Test Operations and Support Contract (TOSC) at the Kennedy Space Center (KSC) in Florida.

Following a tour in the U.S. Marine Corps (VMFA-212, Fighter Attack Squadron), Ken continued his career with Boeing, then McDonnell Douglas, on the Cruise Missile Program in Florida. During the next several years, he supported several Boeing programs such as the Space Shuttle Program, SpaceLab and SpaceHab Programs. In 1995, Ken was assigned, as a Systems Engineer, to the Italian built, Multi-Purpose Logistics Module (MPLM) carrying cargo & supplies directly supporting the International Space Station Program. He was responsible for MPLM ground processing which includes both pre and post launch activities. In 2013, following the Space Shuttle fly-out, Ken joined ERC, INC. and was assigned, as a Senior Quality Engineer, as a teammate on the KSC-TOSC contract. As a Safety & Mission Assurance representative, he now is responsible for ensuring NASA -TOSC contractual requirements are achieved and maintained, both for ground and flight processing, which includes the International Space Station (ISS) and Space Launch System (SLS) Programs.

Ken graduated from Embry-Riddle Aeronautical University with a Bachelor of Science in Professional Aeronautics in December 15, 1992 and an MBA in Aviation Management in December 15, 1997. He has received several professional commendations and is actively engaged in manned space flight education programs in local area schools.

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Chapter 17. Astronaut Operations – Greg E. Chamitoff, Marcum Reagan, and Tyler Peterson

Marcum Reagan



Marc Reagan has a B.S. in Aerospace Engineering from Texas A&M, and an M.S. in Aerospace Engineering Sciences from the University of Colorado, which he attended on a NASA Fellowship. He started at the Johnson Space Center (JSC) in 1987 as a Co-op student, and has been there since. Professional duties have included being a Shuttle Systems Instructor, Station Training Lead, Group Lead of the International Space Station (ISS) Systems Training Group, and Lead of the Chief Training Officer Office. He was selected as one of the first non-astronaut Capcoms for the ISS, and has worked every increment since certifying on Increment 5 (60 and counting), making him the longest continually serving ISS Capcom.

In 2000 he helped form the NASA Extreme Environment Mission Operations (NEEMO) Project. He served as crew backup and Topside support for NEEMO 1 in 2001, then served as an aquanaut crewmember on the 9-day NEEMO 2 mission in May, 2002. He has remained instrumental in the success of the project, generally serving as the lead Mission Director and as a support diver, and has since has served on 3 more saturation missions in the Aquarius habitat, for a total of 22 cumulative days of living and working under the sea. In part due to his efforts, there have been 23 safe and successful NEEMO missions to date.

He currently helps lead the development and execution of human spaceflight mission analogs (including NEEMO) in preparation for the human return to the lunar surface as part of NASA's Artemis Program, and continues to support the ISS Program as a Capcom.

Tyler Peterson



Tyler Peterson earned his PhD from the Texas A&M History Department in May 2017. His dissertation focused on the history of astronaut training from the Mercury program through the International Space Station era, featuring new research drawn from several archival collections and interviews with 8 astronauts as well as 11 Johnson Space Center Training Division personnel. Rob Godwin of Apogee Books, an imprint of the Canadian publishing house Collector's Guide Publishing and the most prolific publisher of spaceflight literature in the world, agreed to turn this project into a published book. The Apogee book A Fire to be Lighted: The Training of American Astronauts From 1959 to the Present went on sale in December 2017. Tyler currently resides in Cedar Falls, Iowa and plans to continue researching and writing about the history of human spaceflight as his career progresses.

Epilogue – Mark McDonald



Mark McDonald is the Chief Architect for the Space Technology Mission Directorate (STMD) at NASA Headquarters. In this role, he provides executive leadership in establishing a long term vision for STMD investments, with an annual investment value of over $1 billion.

McDonald was the international formulation team lead for the Gateway Lunar Architecture from 2012 through 2018. Previously, McDonald served in many managerial roles at Johnson Space Center including Deputy Manager of the Design Integration Office in the Constellation program, the Branch Chief of the Avionics Systems Division's Product Development Branch, the deputy manager of Avionics Project Management Office, and Chairman of the International Space Station Architecture Integration Team. McDonald began his NASA career in 1987 as an electrical engineer at Jet Propulsion Laboratory and transferred to Johnson Space Center in 1990.

McDonald has a bachelor's degree in electrical engineering from the Texas A&M University and a Master's Degree in Aerospace Engineering from the University of Southern California. He has received numerous NASA awards and honors including a 2020 Silver Achievement Medal, 2013 NASA Exceptional Achievement Medal, a 2004 Silver Snoopy Award and 2000 & 2001 Space Flight Awareness Awards. Mark has flown on NASA's Vomit Comet zero gravity experience aircraft three times and is an avid SCUBA diver, traveler and enjoys writing poetry and drawing. Mr. McDonald was raised in Colorado Springs, Colorado. He is married to Heather McDonald and has two children.

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