Space Operations
Beyond Boundaries to Human Endeavours

Editors
Craig Cruzen
Michael Schmidhuber
Young H. Lee

SpaceOps 2021 Conference Book

This book is unique: In times of a global Corona pandemic, travel restrictions and social distancing this conference book provides you with the opportunity to catch up on the latest developments and plans in the field of space operations WITHOUT leaving your save environment and spending more time "in the interface" than learning something new.

The 2021 SpaceOps Conference was hosted at Cape Town by the South Africa National Space Agency (SANSA) SpaceOps 2021 as Virtual Edition from 3-5 May 2021.

The Conference book summarizes the most relevant papers presented during the weeklong virtual conference, being reviewed and selected for your benefit by experienced experts in their fields.

Before the Corona pandemic in 2018, when the theme of the 2020 conference "Beyond border in Human Endeavor" was decided, the SpaceOps Organization (SpaceOps) wanted to show that the international space operations community recognized that most borders are artificial in their nature and that successful missions require cooperation across national boundaries but also across public and private sectors, industry and academia. The advent of the pandemic further emphasized this tighter national control, but thankfully the tools were available to overcome these restrictions and to continue with the preparations.

The topics for SpaceOps 2021 saw an expansion from the previous conference, with papers organized along the following topics: (1) Mission Design and Management, (2) Operations Concepts, (3) Flight Execution, (4) Ground Systems Engineering, (5) Data Management, (6) Planning and Scheduling, (7) Guidance, Navigation, and Control, (8) Communications Architectures and Networks, (9) Human Spaceflights and Operations, (10) Cross Support, Interoperability, and Standards, (11) Human Factors, Training and Knowledge Transfer, (12) Space Transportation Systems, (13) Artificial Intelligence for Space Operations, (14) Cybersecurity for Space Operations, (15) Safety and Sustainability of Space Operations and (16) Beyond Boundaries in Human Endeavour.

In addition to the regular conference topics, three new topics: artificial intelligence for space operations, cybersecurity and safety and sustainability were added. This reflected their growing importance for space operations.
In total, 263 papers for the 16 topics were presented from 25 different countries with new nations joining, likely because of the virtual nature of the conference.

The free registration allowed a much larger attendance, with 2,730 registrations and 1,935 actual participants.

As usual, the organizers of SpaceOps 2021 decided to publish a book of the 30 "best" papers reflecting important subjects and new developments.

The selected thirty papers are sub-summarized under three topics (1) Mission Management, (2) Ground System Software, (3) Flight Operations.

In order to provide some flavor I selected my personal favorites from each of the three topics:

Automated Software for Crewed Spacecraft—Bridging the Gap from Sci Fi to Reality: With a voice command or a few taps on the console, the spacecraft pivots on a dime at high velocity and gently docks to an orbiting space platform. This is the image most people have of the complex software computations and integrated hardware performance necessary for a spacecraft to successfully perform an automated launch, rendezvous, and docking. Today's reality is that while computer operations are advancing rapidly, science fiction over-simplifies and over-sells current capabilities. This paper discusses the integration of spacecraft computer automation into the operation of one of the United States' new Commercial Crew vehicles—the Boeing CST-100 Starliner.

New Questions Opened by the Big Data in the World of the Science Data Processing Centre for Gaia Mission in CNES: On 16th of July 2019, the ESA's Gaia satellite started his first mission extension after 5 years of producing operational observations (since 25th of July 2014). This mission is the successor of Hipparcos ESA's satellite with the same objective of publishing a catalogue of stars and objects (galaxies, asteroids, etc.) but up to 1 billion objects (against 2.5 million). Gaia catalogue will determine the position, the distance and the movement of each object. To achieve this goal, a consortium, called DPAC, has been created to process all the satellite's data composed of more than 450 people mostly in Europe (including scientists and engineers). 9 Coordination Units (CU) corresponding to dedicated themes and 6 data processing centres (DPCs) have been created. CNES is in charge of 3 scientific CUs (with 7 scientific pipelines) in operations, called DPCC.

The presentation will describe the tools implemented at DPCC to monitor each run (with Hadoop tools or dedicated ones developed by DPCC) part of the full pipeline execution leading to data catalogue, with the objective to optimize the configuration (software development or Hadoop configuration) for the preparation of the next Gaia catalogues.

ISS Payload Operations Training Throughout the COVID-19 Pandemic: Impacts, Opportunities and Solutions: A very topical issue, this paper discusses the factors and solutions payloads operations trainers found to keep scientific research on the ISS flying forward to mission success. Teaching to large groups took additional shifts in the training paradigm. Methods for preparing astronauts for their missions were revised. Simulation supervisors found efficient techniques to provide realistic training experiences. Communication and coordination with management was essential. In every case, the payload operations instructors found novel solutions to all functions listed.