

2017 IAA Symposium on Small Satellites for Earth Observation

Conference Report

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24-28 April 2017

Berlin Brandenburgische Akademie der Wissenschaften (BBAW);

Berlin, Germany

With the successful conclusion of the 11th International Academy of Astronautics Symposium on Small Satellites for Earth Observation, held the 24-27th of April 2017, as the Chief Rapporteur I am pleased to provide the following summary report. Gathering again at the Berlin Brandenburg Academy of Sciences, we enjoyed not only great hospitality and accommodation, but another successful gathering of more than 250 representatives from across the industry, government, and academic institutions of 37 countries. The symposium was opened by a motivating keynote address, followed by not only a rich technical program with more than 60 paper presentations across 15 sessions, two poster sessions comprised of nearly 50 summaries, but also an exhibition with a wide array of system and subsystem offerings needed for developing small satellite missions, launch accommodation, ground services, and information processing. A highly competitive student conference again highlighted exciting new contributors to the space community, featuring six finalists from four continents. Awards were given for both best papers and posters, as determined by committee and participant voting. Finally, not to be missed were also the many enjoyable social opportunities and local excursions made possible by the symposium and supporting organizations, including a hosted reception at the Archenhold Observatory.

The symposium was honored to receive the Director General of the European Space Agency, Professor Jan Woerner, for his keynote address titled, “The Role of Small Satellites for United Space in Europe.” In his remarks Professor Woerner touched upon the many ways in which the global community is tackling broad challenges using space, including those driven by information, communication, science, and technology endeavor, but also for education, inspiration, and pure curiosity. To frame the thesis of his talk, he acknowledged an evolving space history that began with early astronomy (Space 1.0), then a race in space (Space 2.0), progressive steps for global cooperation and space applications (Space 3.0), and now a new era: Space 4.0. With particular emphasis, he expressed concern that the European spirit is endangered, with more cooperation needed in order to persist and endure through “bad weather conditions” and beyond individual agendas, to build a seamless grid of innovation by leveraging the many diverse partnerships that exist, to build the United States of Europe.

In Space 4.0, Professor Woerner reflects that the global community is now catalyzed by a diverse paradigm shift comprised of new space actors (e.g., nations, industries, universities), expanding uses/applications of space, changing roles (e.g., government focus vs. commercial markets), and new enabling methods/technologies (e.g., digitalization). Within this context, he posits, ESA must serve as the agency, broker, mediator, and enabler for global cooperation. To this end, an

2017 IAA Symposium on Small Satellites for Earth Observation

EU-ESA Joint Statement has been issued focused on the full integration of space into European economy and society, promoting a globally competitive European space sector, and ensuring European autonomy in accessing and using space. Achieving these outcomes will require out of the box thinking and the application of fundamental research to real-world problems and innovations. Professor Woerner provided several examples, including how special/general theories of relativity are impacting advances in satellite navigation capabilities, as well as how a seamless grid of innovation is fueling business incubation across the whole enterprise lifecycle, evidenced by technology transition from space programs to commercial applications as in the case of the imaging system on Philae now being used for early forest fire detection.

In the technical sessions that followed, a diverse array of papers were presented spanning missions, instruments, lessons learned, programmatics, new spacecraft platforms, cubesats, and enabling subsystem designs. These talks were all of high quality and relevance, received by a full auditorium with many good question-and-answer exchanges. Moreover, the collective body of topics addressed also had strong linkages to many of the remarks shared in Professor Woerner's keynote address. When considered in their full context, four important, topical points were made that served to frame the current state of the community from both a capability and challenges perspective, as well as set a projected trajectory for where we are collectively headed:

1. Small satellites can be used for important science and commercial missions, but their employment and end-user application considerations are essential for developing the appropriate capability. In this regard, many examples were provided throughout the symposium, including that of the NASA CYGNSS mission, TripleSat (SSTL/21st Advanced Century), and the transition of FireBIRD from pathfinder to operationalized system as a small constellation of two satellites contributing to the Global Forecast System and humanitarian response efforts.
2. SmallSat market growth using nano/microsatellites is principally being driven by Earth observation (today) and communications (coming), however, there are many new applications being investigated and demonstrated, including those pertaining to: disaster monitoring, maritime domain awareness, novel uses of compact hyperspectral instruments, greenhouse gas detection, climate change by way of Earth's energy balance (APL/NASA RAVAN), and continued experiments supporting air traffic management pursuant to operationalization and commercialization (e.g., CanX-7 and GOMX-3).
3. The business model for space-based solutions is rapidly evolving as private sector investment and commercial market opportunities are producing myriad new endeavors outside of traditional government support. NewSpace, as it is called, is driven by combination of new business philosophies, aggressive technology management, alternate framework considerations, and external (private) financing, where space is regarded as a means for delivering new applications and accessing new markets or cost models. Looking forward, governments are now seeking to leverage the capabilities and agility of these new offerings

2017 IAA Symposium on Small Satellites for Earth Observation

through, among many means, public-private partnerships as was noted in Professor Woerner's keynote remarks.

4. With an eye to the future, it was noted that there remains both obstacles and enablers to advancing the use of small satellites to provide global value. With respect to the former, there remains need for producing observations outside typical temporal windows; attention to stewardship and mitigation of space debris; continued efforts to surmount a complicated regulatory environment for spectrum access; and a need for suitably tailored quality and mission assurance processes for small satellite missions that strike a balance between necessity and pragmatism (e.g., ESAIL with ESA). This latter point was underpinned by remarks in the keynote that program risk posture and oversight must be consistent with what is acceptable relative to the mission type/purpose (e.g., demonstration test, security related/infrastructure/operational system, people). Excitingly, work was presented that highlighted areas of optimism and new endeavor, including use of hybrid and heterogeneous space-airborne mission architectures; conducting operations in very low-LEO at altitudes under 300 km using electric propulsion to maintain orbit for diverse, hi-resolution remote sensing applications; aggregating "big data" from multiple, different sources utilizing intelligent processing and fusion techniques to create new knowledge products; and numerous other examples spanning quantum entanglement (telecommunications), super-sampling/super-resolution, and advanced/additive manufacturing methods.

In conclusion, the symposium was another success, providing a great opportunity for technical exchange, broad community engagement, and communication across a diverse international representation. More importantly, it brought forward both new ideas and the opportunity to discuss common challenges to developing important earth observation missions using small satellites. It has been my honor to take the mantle of responsibility as the Chief Rapporteur from Dr. Eberhard Gill, who at the last symposium revisited his question of "Quo vadis? Where are we going?" I believe we have discussed several aspects this week that provide a roadmap for the future and I look forward to seeing where we are upon our return to Berlin two years hence.

Finally, the symposium organizers would like to acknowledge the passing and memory of the conference co-founder, Dr. Hans-Peter Roeser.

2017 IAA Symposium on Small Satellites for Earth Observation

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Date Submitted: 27th April 2017

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