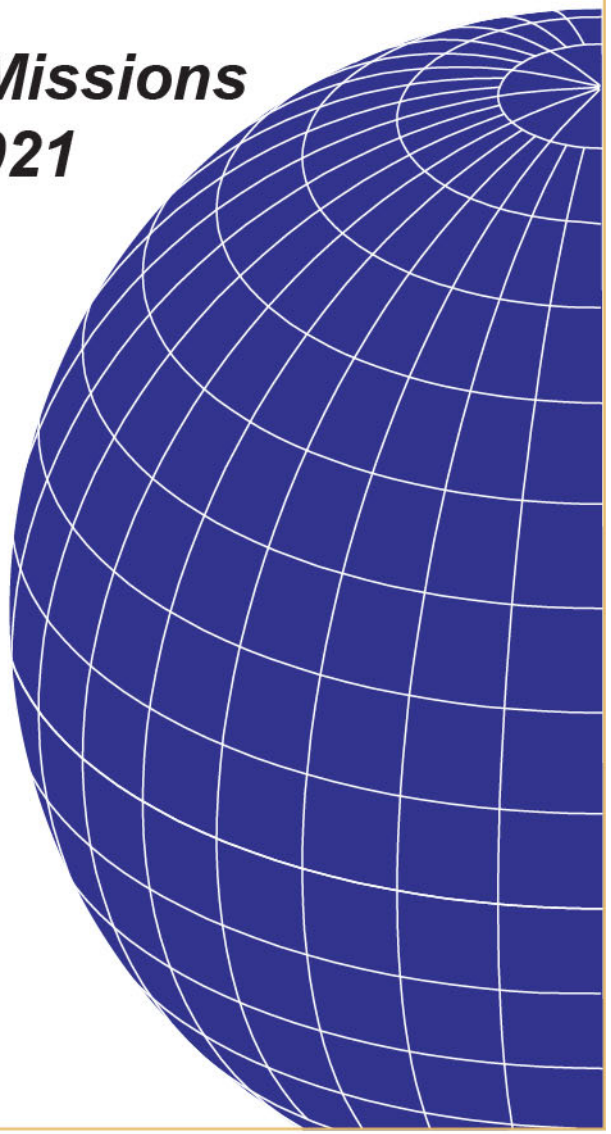
Reinventing Space:
Low-Cost, Responsive Space Missions
USC ASTE 523, Spring 2021



Supplement 9A

The 100 (or so) Most Important Books in Space Technology

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY

Note 1: This is intended as a very practical list. It isn't a list of the most interesting, most scholarly, or best written books, but rather a list of where to go to get the information you need if you're working in the field of space technology. Consequently, I've collected the list by topic and occasionally by subtopic. Also, rather by definition, the list has a great deal of personal selection. These books are not necessarily the most popular or most widely sold or circulated, but are the ones I would recommend to associates to get the information they need to solve practical problems in space technology. Where appropriate, a few books are listed in more than one category. Comments, suggestions, recommended additions, and nasty remarks are always welcome. It's a dialog worth having. Jim Wertz, wertz523@smad.com

Note 2: With the publication of Space Mission Engineering: The New SMAD, we now have a much more complete annotated bibliography on the web at http://www.sme-smad.com. (You'll need the password from the inside front cover of the book.) It also takes you where you can go on the web to obtain each of the references. Some are free. Most are books or papers from one of the professional societies that must be purchased. As above, suggestions for additions would be appreciated.

Mission Engineering

General

Maier and Rechtin, *The Art of Systems Architecting, 3rd ed*.

Wertz, Everett, and Puschell, *Space Mission Engineering: The New SMAD*

Wertz and Larson, *Space Mission Analysis and Design, 3rd ed.*

Fortescue, Stark, and Swinerd, *Spacecraft Systems Engineering, 4th ed.*

Griffin and French, *Space Vehicle Design, 2nd ed.*

Pisacane and Moore, *Fundamentals of Space Systems, 2nd ed.*

Harland and Lorenz, *Space Systems Failures*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Low-Cost Missions

Ford, *The ARRL Satellite Handbook*

Wertz and Larson, *Reducing Space Mission Cost*

Sarsfield, *Cosmos on a Shoestring*

Available at: http://www.rand.org/publications/MR/MR864

Helvajian and Janson, *Small Satellites: Past, Present, and Future*

Shiroma and Thakker, *The Emergence of Pico- and Nano-Satellites*

Fleeter, *The Logic of Microspace*

London, *LEO on the Cheap*

Available at: http://www.dtic.mil/get-tr-doc/pdf?AD=ADA289106

Wertz, *Reinventing Space: Dramatically Reducing Space Mission Cost and Schedule*

In Preparation

Human Spaceflight

Eckart, *Spaceflight Life Support and Biospherics*

Larson and Pranke, *Human Spaceflight*

Clement, *Fundamentals of Space Medicine*

Kanas and Manzey, *Space Psychology and Psychiatry, 2nd ed.*

Harrison, *Spacefaring: The Human Dimension*

Semi-Technical

Sellers, *Understanding Space: An Introduction to Astronautics, 3rd ed.*

Campbell, *Introduction to Space Sciences* (Out of Print)

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Non-Technical

Logsdon, *Going Up* (for kids)
Hartman, *A Traveler's Guide to Mars*
Frommer's, *The Moon* (Out of Print)

Management (Aren't any good books)

Shirley, *Managing Martians*
Ruskin and Estes, *What Every Engineer Should Know About Project Management, 2nd ed.*
Demarco, *Peopleware: Productive Projects and Teams, 2nd ed.*

General and Reference

Longuski, *Advice to Rocket Scientists*
Light, *Full Moon* (Out of Print)
Angelo, *Dictionary of Space Technology*
Martin, *Communication Satellites, 5th ed.*
Krauss, *The Physics of Star Trek*
Gruntman (history), *Blazing The Trail*

Mission Geometry

Wertz, *Orbit and Constellation Design and Management*
Taff, *Computational Spherical Astronomy*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Astrodynamics and Orbit Design

Bate, Mueller, and White, *Fundamentals of Astrodynamics*

Battin, *Introduction to Mathematics and Methods of Astrodynamics*

Chao, *Applied Orbit Perturbation and Maintenance*

Chobotov, *Orbital Mechanics, 3rd ed.*

Curtis, *Orbital Mechanics for Engineering Students, 2nd ed.*

Escobal, *Methods of Orbital Determination, 2nd ed.*

Roy, *Orbital Motion, 4th ed.*

Vallado, *The Fundamentals of Astrodynamics and Applications, 4th ed.*

Seidelmann, *Explanatory Supplement to the Astronomical Almanac*

Kaplan, *Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models*

Available at: http://aa.usno.navy.mil/publications/docs/Circular_179.html

Soop (geostationary), *Handbook of Geostationary Orbits*

Logsdon (non-mathematical), *Orbital Mechanics: Theory and Applications*

Mallove and Matloff (interstellar flight), *Starflight Handbook: Pioneer's Guide to Interstellar Travel*

Gurzadyan (interplanetary), *Theory of Interplanetary Flights*

Brown (interplanetary), *Spacecraft Mission Design, 2nd ed.*

Wertz, (orbit design), *Orbit and Constellation Design and Management*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

The Space Environment

Environmental Effects

Tribble, *The Space Environment: Implications for Spacecraft Design, 2nd ed.*

Knipp, *Understanding Space Weather*

Daglis, *Effects of Space Weather*

Milne, *Sky Static: The Space Debris Crisis*

DeWitt, et al., *Behavior of Systems in the Space Environment* (Out of Print)

AIAA, *MEO/LEO Constellations: US Laws, Policies and Regulations on Orbital Debris Mitigation*

AIAA, *Guide to Reference and Standard Ionosphere Models*

AIAA, *Guide to Modeling the Earth's Trapped Radiation Environment*

Space Resources and Reference Data

Cox, *Allen's Astrophysical Quantities, 4th ed.*

Heiken, et al., *Lunar Sourcebook: A User's Guide to the Moon* (Out of Print)

Lewis, et al., *Resources of Near-Earth Space* (Out of Print)

Kieffer, et al., *Mars*

Gehrels, *Hazards Due to Comets and Asteroids*

Greeley and Batson, *Compact NASA Atlas of the Solar System*

McFadden/Weissman, et al., *Encyclopedia of the Solar System, 2nd ed.*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Payloads

Observation Payloads

Chen, *Space Remote Sensing Systems: An Introduction* (Out of Print)

Elachi, *Introduction to the Physics and Techniques of Remote Sensing, 2nd ed.*

Cruise, et al., *Principles of Space Instrument Design*

Lillesand, *Remote Sensing, 6th ed.*

Communications Systems

Elbert, *Introduction to Satellite Communications, 3rd ed.*

Kadish and East, *Satellite Communication Fundamentals (with software)*

Gordon and Morgan, *Principles of Communication Satellites*

Morgan and Gordon, *Communications Satellite Handbook*

Maral and Bousquet, *Satellite Communications Systems, 5th ed.*

Other Payloads

Glaser, *Solar Power Satellites, 2nd ed.*

Lacomme, *Air and Spaceborne Radar Systems*

Genta, *Introduction to the Mechanics of Robots*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Spacecraft Bus and Susbystems

Griffin and French, *Space Vehicle Design, 2nd ed.*

Gordon and Morgan, *Principles of Communication Satellites*

Morgan and Gordon, *Communications Satellite Handbook*

Brown, *Elements of Spacecraft Design*

Eikhoff, *Simulating Spacecraft Systems*

Attitude Determination and Control

Chobotov (so-so), *Spacecraft Attitude Dynamics and Control, 2nd ed.*

Wertz (old), *Spacecraft Attitude Determination and Control*

Bryson, *Control of Spacecraft and Aircraft*

Power

Hyder, et al., *Spacecraft Power Technologies*

Patel, *Spacecraft Power Systems*

Thermal

Karam, *Satellite Thermal Control*

Donabedian, et al., *Spacecraft Thermal Control Handbook, 2nd ed., Vol. II: Cryogenics*

Gilmore, *Spacecraft Thermal Control Handbook, 2nd ed., Vol 1: Fundamental Technology*

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Structures

Sarafin and Larson, *Spacecraft Structures and Mechanisms*

Conley, *Space Vehicle Mechanisms*

Guidance and Navigation, including GPS

Hoffman-Wellenhof, *GPS: Theory and Practice, 5th ed.*

Parkinson, *Global Positioning System: Theory and Application, Vols. I and II*

Emadzadeh and Speyer, *Navigation in Space by X-Ray Pulsars*

Propulsion

Sutton, *Rocket Propulsion Elements, 8th ed.*

Sutton, *History of Liquid Propellant Rocket Engines*

Humble, *Space Propulsion Analysis and Design*

Launch

Isakowitz, *International Reference Guide to Space Launch Systems, 4th ed.*

Chiulli, *International Launch Site Guide*

London, *LEO on the Cheap*

Available at: http://www.dtic.mil/get-tr-doc/pdf?AD=ADA289106

THE 100 (OR SO) MOST IMPORTANT BOOKS IN SPACE TECHNOLOGY (cont.)

Operations

Wall and Ledbetter, *Design of Mission Operations Systems for Scientific Remote Sensing*
Boden, Squibb, and Larson, *Cost Effective Space Mission Operations, 2nd ed.*

Computer Systems and Software

Rainey, *Space Modeling and Simulation*

Cost Modelling and Economics

Canada, et al., *Capital Investment Analysis for Engineering and Management, 3rd ed.*
Greenberg, *Economic Principles Applied to Space Industry Decisions*
Greenberg and Hertzfeld, *Space Economics*
Koelle, *Transcost 8.0 — Handbook of Cost Engineering* (Rev 3 – 2010)

Law and Politics

Canada, et al., *Capital Investment Analysis for Engineering and Management, 3rd ed.*
Klerkx, *Lost in Space*
Johnson, *The Secret of Apollo*
Goldman, *American Space Law: International and Domestic, 2nd ed.*
Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Use of Space*
Seedhouse, *The New Space Race: China vs. the United States*

Reliability and Risk

Hecht, *Systems Reliability and Failure Prevention*
Harland and Lorenz, *Space Systems Failures: Disasters and Rescues of Satellites, Rockets, and Space Probes*

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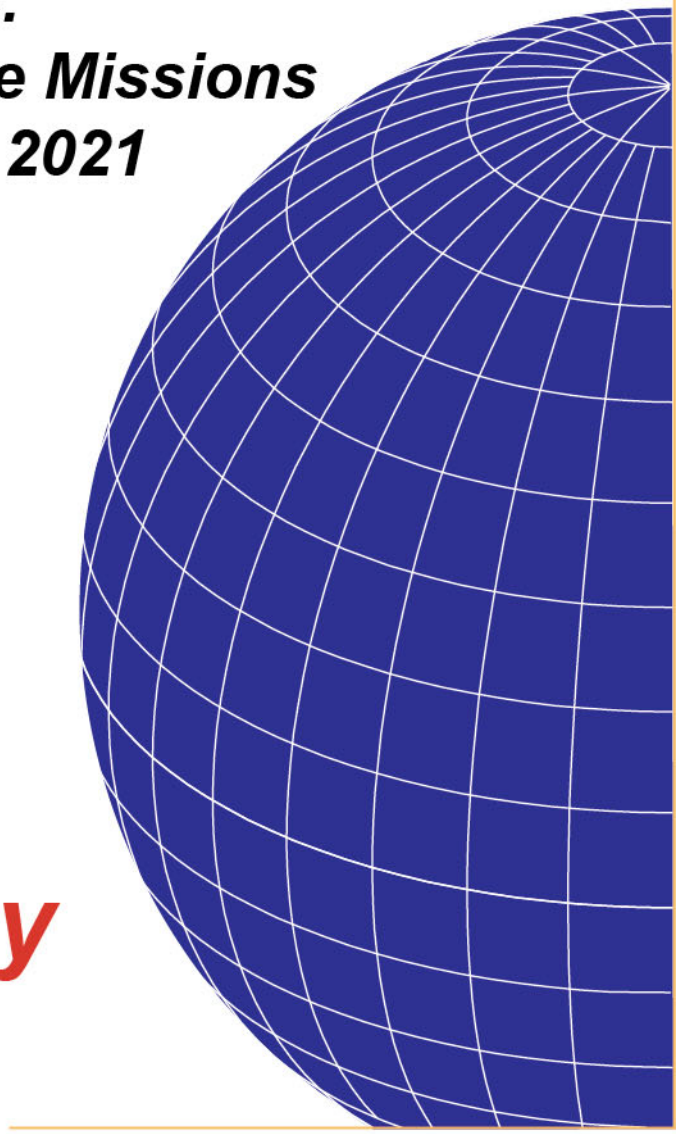

Supplement 9B

Reducing Space Mission Cost Annotated Bibliography

REDUCING SPACE MISSION COST
ANNOTATED BIBLIOGRAPHY

Note: This is intended as a very practical list of the best sources of information on reducing space mission cost. I have largely excluded discussions of approaches that may be physically possible, but are not yet technically feasible, such as the space elevator. I have also excluded discussions of particular pieces of hardware, such as a low-cost solar array or low-cost star sensor. While these may well be relevant, they do not typically drive the mission cost. Of course, most of the articles tend to be supportive of a particular technology or approach, but that is also true of the space technology literature in general. A number of the books and articles are relatively old. In this case, the methods and techniques may well still be applicable although the cost data will be out of date or incorrect**. If you are aware of other books, conferences, courses, professional papers, or study reports that we have not included and which meet the above criteria, please let me know at the E-mail address below.**

Finally, thanks to Nicola Sarzi-Amade, Donna Klungle, and Anthony Shao of Microcosm for their assistance in collecting material for this bibliography.

Jim Wertz, wertz523@smad.com

Books

Helvajian, H. and S. W. Janson (eds.), 2009, ***Small Satellites: Past, Present, and Future***, 859 pg., Los Angeles, CA: The Aerospace Press, October 30, 2009.

Provides an extensive history of smallsats and projections for future use. Provides a detailed overview of The Aerospace Corp's picosat program and their approach to testing technologies on picosats in order to mitigate risk on larger missions and advance the exploitation of space more quickly and at lower cost. [For the results of a Futron study funded by AFRL of the future of small satellites, see the professional paper by Foust, et al., 2008; see also the paper by Wertz, 2010.]

Books (cont.)

McCurdy, 2003. ***Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program***. Baltimore, MD: John Hopkins U. Press. 192 pg.

An historical overview of the "faster, better, cheaper" program introduced by NASA Administrator Dan Goldin. Discusses 16 specific NASA missions undertaken during the 1990's and the successes and failures of the program.

Sandau, R., 2006. ***International Study on Cost Effective Earth Observation Missions***, Leiden, The Netherlands: A. A. Balkema, 180 pg.

Contributions by multiple international authors on the general process of creating low-cost Earth observation missions. See also the IAA Symposium on Small Satellites for Earth Observation listed under conferences.

London, J.R. 1994. ***LEO on the Cheap — Methods for Achieving Drastic Reductions in Space Launch Costs***, Maxwell AFB, AL: Air University Press. 213 pg.

An older study, but still the most definitive study available of launch system cost and methods of reducing them. Summarizes existing and proposed launch systems with particular emphasis on the reasons for high cost and the methods required to drive down cost. Available at no cost at www.dtic.mil/get-tr-doc/pdf?AD=ADA289106

Books (cont.)

Sarsfield, L., 1998. ***The Cosmos on a Shoestring — Small Spacecraft for Space and Earth Science***, Santa Monica, CA: RAND Corp., 221 pg.

This is the final report of a RAND Corp. study on using small spacecraft for space and Earth science missions. Includes an extensive bibliography. Available at no cost at: http://www.rand.org/publications/MR/MR864

Davidoff, M., 1998. ***The Radio Amateur's Satellite Handbook, 2nd edition***. Newington, CT: ARRL. 370 pg.

This AMSAT book provides a detailed recipe for the design and operation of very low-cost communications satellites; practical, relevant data and methods applicable to many missions; lots of references. Out of print. Replaced by Ford, below. Still an excellent reference with more detail than the Ford book.

Ford, S., 2009. ***The ARRL Satellite Handbook***. Newington, CT: ARRL. 208 pg.

This is the replacement for the 1998 Davidoff volume. Primarily oriented toward ground stations and ground users. Provides a brief history of amateur radio satellites, satellite orbits and tracking, satellite communication systems, satellite ground stations, satellite operating, and amateur satellite projects. An excellent reference from one of the most successful, low-cost satellite organizations in the world.

REDUCING SPACE MISSION COST
ANNOTATED BIBLIOGRAPHY (cont.)

Books (cont.)

Wertz, J.R. and W.J. Larson, 1996**. *Reducing Space Mission Cost***, Dordrecht, The Netherlands: Kluwer Academic and Hawthorne, CA: Microcosm Press, 629 pg.

An older book, but still the only volume available that directly addresses all aspects of space mission cost reduction. Includes 10 case study missions from various areas with both extended discussions and detailed costs for each. Intended as a practical guide to reducing mission cost and to what works and what doesn't work in reducing cost. Extensive references.

Fleeter, R., 2000. ***The Logic of Microspace***, Dordrecht, The Netherlands: Kluwer Academic and Hawthorne: Microcosm Press, 447 pg.

An excellent volume by the former president of Aero-Astro. Well-written — likely the most entertaining book available on small satellites. Discusses both the technology and management of low-cost space missions. Well worth reading for practical advice on truly changing the rules of the game for space business and creating reliable, low-cost spacecraft.

Harland, D.M. and R.D. Lorenz, 2005. ***Space System Failures — Disasters and Rescues of Satellites, Rockets, and Space Probes***, Chichester, UK: Praxis Publishing, 368 pg.

This book is not directly associated with reducing space mission cost, but I have included it in the list because it is the most authoritative book available on space system failures. And the process of trying to avoid failures has been a major driver of cost increases in the space program.

Books (cont.)

Johnson, S.B., 2002. ***The Secret of Apollo: Systems Management in American and European Space Programs***, Baltimore, MD: Johns Hopkins University Press, 290 pg.

The Apollo Moon program was the single most expensive space program in history. However, it was also remarkably successful in many respects — landing a man on the Moon only 8 years from the start of the program, including the development of the Saturn V, the largest, most reliable, and lowest cost per pound launch vehicle ever built. Johnson tells the story of the development of the Systems Management process that allowed Apollo to happen.

Committee on Cost Growth in NASA Earth and Space Science Missions, and National Research Council, 2010, ***Controlling Cost Growth of NASA Earth and Space Science Missions***, 76 pg., Washington, DC: National Academies Press, September 21, 2010.

This report is the result of a study of recent NASA science missions. It finds 4 primary causes of cost and schedule growth and makes 11 recommendations to control this problem and reduce cost and schedule.

Speretta, S., 2012. ***Design Solutions for Low-cost Space Missions: New Approaches to Design Reliable Space Systems***, Mauritius, Germany: LAP LAMBERT Academic Publishing, April 18, 2012, 179 pg.

This book addresses the complete problem of creating low-cost spacecraft, but is less comprehensive than the title suggests. Much newer than other book-length treatments.

Books (cont.)

Wertz, J.R. (In preparation.) R**einventing SMAD, Methods for Dramatically Reducing Space Mission Cost and Schedule**. Hawthorne, CA: Microcosm Press.

Reinventing SMAD (R-SMAD) is the process of going about changing how we do business in space in order to achieve a high level of mission utility and better mission reliability at dramatically lower cost and with a much shorter schedule, such that space missions can be responsive to both world events, such as natural or man-made disasters, and changing technology. This is a worthwhile set of objectives, but is it realistic? R-SMAD both establishes specific quantitative objectives and points out that, although nothing is guaranteed in future programs, it is certainly realistic to expect major and dramatic cost and schedule reductions in a great many future space programs, if we are aggressive in how we go about it.

Conferences

There are eight principal conferences that are strongly associated with low-cost or reduced-cost, more responsive space programs — four in the US and four at various international locations.

AIAA/USU Small Satellite Conference, held annually in August at Utah State University in Logan, UT. The 29th SmallSat Conference will be Aug. 8–13, 2014. An excellent conference which nearly all of the small satellite community attends. Past proceedings on CD are for sale on conference website, www.smallsat.org. List of paper titles and authors available online. If you attend, be sure to make hotel reservations early. Logan is a small town and is usually filled up by the conference, such that late comers may have to stay a long ways away.

Conferences (cont.)

Responsive Space® Conference/Reinventing Space Conference sponsored by the AIAA LA/Las Vegas and Orange County Sections and the Space Systems Technical Committee was held annually in LA in the general vicinity of LAX from 2003 to 2013. In 2011, the name of the conference was changed to Reinventing Space to emphasize the initial purpose of the conference -- much lower cost, more responsive space missions. RS2014 was held Nov. 18–21 at the Royal Society, London, UK. Past papers can be found at www.responsivespace.com and www.rispace.org, which also has contact information, call-for-papers, and a responsive space dictionary and acronym list. Most people and organizations associated with low-cost, responsive space (including the AF Operationally Responsive Space office) will be there.

Small Satellites Systems and Services (4S) Symposium, a biennial event sponsored by ESA with large international participation. All aspects of small satellite programs are considered including flight experiences, mission definition, technologies, launches, ground segment, and data exploitation. The 4S Symposium 2014 was held May 26–30, in Porto Petro, Majorca, Spain. Information is available at www.http://congrexprojects.com/2014-events/4S2014/home.

IAA Symposium on Small Satellites for Earth Observation, sponsored by the International Academy of Astronautics. The 10th symposium will be held April 20–24, 2015 in Berlin, Germany. The conference website (in English) is www.dlr.de/iaa.symp/en/desktopdefault.aspx/tabid-4802/. Papers from previous conferences are available on the website. As the name implies, this is an international symposium on the use of small satellites with a strong orientation toward low cost. This conference is approximately bi-annual and focuses on low-cost interplanetary missions. Details can be found at www.dlr.de/pf/desktopdefault.aspx/tabid-9912/.

Conferences (cont.)

***IAA International Conference on Low-Cost Planetary Missions* (LCPM)**, sponsored by the International Academy of Astronautics. The 10th conference was held June 18–20, 2013 at CalTech in Pasenda, California. Information is available on the IAA website, www.lcpm10.caltech.edu/. The 11th conference will be held June 9–11, 2015 in Berlin, Germany. Papers from most previous conferences are available.

Reducing the Costs of Spacecraft Ground Systems and Operations (RCSGSO), sponsored by the major space agencies. An extensive conference with parallel sessions on topics such as Mission Planning, Autonomous Operations, Software Development, Standardization, Flight Dynamics and Navigation, Global Networks, and Low-Cost Mission Operations Concepts. The 8th RCSGSO conference was held in May, 2009, at JAXA Tsukuba Space Center, Japan.

CubeSat Developers' Workshop, was held annually at Cal Poly in San Luis Obispo, California. The 11th Annual CubeSat Developers' Workshop was held April 23–25, 2014. Past presentations are available at http://www.cubesat.org/index.php. The 12th Annual CubeSat Developers' Workshop will be held Aug. 8–9, 2015 at the AIAA/USU Small Satellite Pre-Conference Workshop. Information is available at www.smallsat.org/technical-program/workshop.

Interplanetary CubeSat (iCubeSat) Workshop is funded by more than 100 academic, commercial and non-profit entities and private individuals. The 4st Interplanetary CubeSat will be held May 26–27, 2015 in South Kensington, London, UK. Information is available at http://icubesat.org/.

Courses

There are two courses directly associated with the problem of reducing space mission cost

J. Wertz, ***Reinventing Space: The Design of Low-Cost Space Missions***, taught every other year in the Spring semester as a televised graduate course at USC. (Next course begins January, 2013.) Requires graduate student standing. Best done if the participants have either had a previous SMAD course or, preferably, worked in the space industry. Approximately half the course is lecture on cost reduction approaches and half is discussion based on either current events or questions/issues raised by the participants. Can be taken as a televised course anywhere in the country. However, this is a graded course with homework, mid-term and a final.

This course is also offered from time-to-time as a 5-day short course. This is occasionally done at Microcosm and occasionally at or near an interested organization, most recently for the Canadian Space Agency. For more information, contact Julie Jackson at jjackson@smad.com.

J. Wertz, ***Responsive Space Mission Analysis and Design, R-SMAD***, 5-day short course taught from time-to-time at Microcosm or at sponsoring organizations. The course covers all of the topics in the *Space Mission Analysis and Design* course, but from the point of view of wanting to create truly responsive, very low cost ($20M – $40M) missions.

Professional Papers

Note: Most of the professional papers are discussions of a particular program or technology. Those that discuss cost reduction in more general terms and, therefore, are more broadly applicable are marked with an *.

* Andrews, D. and E. Soerensen, 2003. ***Standardized Mission Operational Methodologies*****,** 5th International Symposium on Reducing the Cost of Spacecraft Ground Systems and Operations, July 8–11 2003, Pasadena, CA.

Andrews, J., 2012. **Spaceflight Services—A New Business Model for the Cost Effective Launch of Small Spacecraft.** RS2012-2012-2001, Reinventing Space Conference 2011, Los Angeles, CA, May 7–11, 2012.

Armstrong, J., and D. Lim, 2012. **A Candid Look at Affordable Launch Landscape to Refocus Our Approach.** RS2012-2012-2005, Reinventing Space Conference 2011, Los Angeles, CA, May 7–11, 2012.

Barabash, S., et al., 2004. ***Towards Low-Cost Swedish Planetary Missions*****,** 24th International Symposium on Space Technology and Science, Miyazaki, Japan, May 30–June 6, 2004.

Barnhart, D.J., T. Vladimirova, and A.M. Baker, 2006. ***A Low-Cost Femtosatellite to Enable Distributed Space Missions*****,** Report No. A039264, 16 pg., Surrey University (Guildford, United Kingdom), Surrey Space Centre, Sept. 20, 2006.

Bauer, T.P., R.C. Conger, J.R. Wertz, and N. Sarzi-Amade, 2010, ***Design, Performance, and Responsiveness of a Low-Cost Micro-Satellite Launch Vehicle*****,** RS8-2010-5003, 8th Responsive Space Conference, March 8–11, 2010, Los Angeles, CA.

Professional Papers (cont.)

Beavis P., M. Götzelmann, 2012. **Evolution of a Low-Cost Ground Station Network**. 1275160, SpaceOps 2012, Stockholm, Sweden, June 11–15, 2012.

Bermyn, J., 2010, ***Proba Spacecraft Family — Affordable Small Mission Solutions for Earth Orbit***. RS8-2010-7005, 8th Responsive Space Conference, March 8–11, 2010, Los Angeles, CA.

* Branco, M.S.A., G. Loureiro, and L.G. Trabasso, 2007. ***Space Mission Architecture Trade-off Based on Stakeholder Value***, (book chapter), *Complex Systems Concurrent Engineering*, Part 2, pg. 91–98, London: Springer.

* Brewer, A.M., 2007. ***Using COTS to Reduce Cost and Mitigate Risk in Support of the Vision for Space Exploration***, AIAA Houston Section, Annual Technical Symposium, ATS 2007.

Burt, R., 2010, ***Cost Advantages of Modular Scalable Avionics***, RS8-2010-4001, 8th Responsive Space Conference, March 8–11, 2010, Los Angeles, CA.

Deininger W.D., L. Andreozzi, K.W. Epstein, E.L. Norman-Gravseth, W. Purcell, 2001. ***Micromission Spacecraft-a Low-Cost, High-Capability Platform for Space Science Missions***, Aerospace Conference 2001, Big Sky, MT, IEEE Proceedings, vol. 1, pg. 1/33–1/40.

* Deloitte Consulting LLP, 2008**. *Can We Afford Our Own Future? Why A&D Programs are Over-Budget and What Can Be Done to Fix the Problem***. Corporate report available at http://www.deloitte.com/dtt/article/ 0,1002,sid%253D2223%2526cid%253D233750,00.html.

* Foust, J., D. Vaccaro, C. Frappier, and D. Kaiser, 2008. ***If You Build It, Who Will Come? Identifying Markets for Low-Cost Small Satellites***. Paper No. SSC08-I-1, presented at the 22nd AIAA/USU Conference on Small Satellites, Logan, UT, August 11–14, 2008.

Professional Papers (cont.)

Giaretta, D. et al., 1998. ***Cost Savings vs. Cost Effectiveness of Space Missions and the Use of CCSDS Panel 2 Standards***, SpaceOps '98, Tokyo, Japan, 1998.

Girolamo, G. D, 1998. ***The Integral Mission Control System (IMCS): Low-Cost Design for a Complex Ground Segment***, Paper ID: 2b013, SpaceOps '98, Tokyo, Japan.

Hamann, R.J. et al., 2008. ***Nano-Satellites for Micro-Technology Pre-Qualification: The Delfi Program of Delft University of Technology***, in *Small Satellites for Earth Observation,* Section 8, pg. 319–330, The Netherlands: Springer.

* Herrell, L. 2009. **A Systems Approach to Lower Cost Missions: Following the Rideshare Paradigm**, AIAA Space 2009 Conference & Exposition, AIAA 2009-6503, September 14–17, 2009, Pasadena, CA.

***** Hogie, K., E. Criscuolo, and R. Parise, 2005. ***Using Standard Internet Protocols and Applications in Space***, *Computer Networks*, ISSN 1389-1286, 2005, vol. 47, no. 5, pg. 603–650.

Huang, P.M., A.G. Darrin, A.Q. Rogers, A.A. Knuth, and Major M.A. Anderson, 2012. **MMBD: A Unique Low-Cost Approach for End-to-End SensorSat Development**. RS2012-2012-3002, Reinventing Space Conference 2011, Los Angeles, CA, May 7–11, 2012.

* Hurley, M. and B. Purdy, 2010. ***Designing and Managing for a Reliability of Zero*****,** European Space Agency 4S Symposium, Funchal, Portugal, May 31–June 4, 2010, Paper No. 1885505.

***** Kitts, C.A. and R.J. Twiggs, 1998. ***Low Cost Space Missions for Education and Technology Research***, 21st International Symposium on Space Technology and Science, Omiya, Japan, May 24–31, 1998.

Professional Papers (cont.)

Kitts, C., et al., 1999a. ***Emerald: An Experimental Mission in Robust Distributed Space Systems*****,** 13th Annual AIAA/USU Conference on Small Satellites, Logan, UT, Aug. 23–26, 1999.

Kitts, C., et al., 1999b. ***Experiments in Distributed Microsatellite Space Systems***, Proceedings of the AIAA Space Technology Conference and Exhibit, Albuquerque, NM, September 28–30, 1999.

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Note: Of particular interest here is the article by Randii Wessen and David Porter on the Cassini Resource Exchange. (The first paper in Vol. 1, No. 1.) This one presents a truly unique and apparently successful approach to constraining cost overruns in science missions with multiple payloads.

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