

ENROLL NOW!

Space Mission Analysis and Design

Taught by Dr. James Wertz at Microcosm, Inc.

The Original SMAD Short Technical Course,
Newly Revised and Expanded



Updated to include material not available anywhere else — the evolution of spacecraft subsystems, the Earth viewed from space, interplanetary round trip missions, and Responsive Space.

Microcosm has enjoyed an international reputation in space mission engineering for over 20 years. Our focus is to develop technologies and solutions to reduce the cost of space — including educating the community! Our courses are based on real life, practical experience with government, civil, and commercial programs both domestic and international.

For current pricing on individual and group discounts please contact Julie Jackson at 310-219-2700. Price includes a copy of *Space Mission Analysis and Design*, 3rd edition, complete course notes, and refreshments.

COURSE DESCRIPTION — This is the original Space Mission Design Course taught by Dr. James Wertz for more than 10 years. It is the most comprehensive space mission analysis course available and has been both updated and modified to provide additional material on space science and recent results on interplanetary round trip missions and Responsive Space. Dr. Wertz's extensive experience and work throughout the space community is invaluable to the participants to support their application of the course material.

The purpose of the course is to guide the participants through the process of preliminary mission design, beginning with a "blank sheet of paper" to create a cost-effective space mission to meet a set of broad, often poorly defined, objectives. The text for the course, developed and published by Microcosm with input from experts throughout the space community, is *Space Mission Analysis and Design*, winner of the AIAA book award and the standard reference in astronautics for over a decade. Both the book and the course are invaluable tools for the concept development process. This seminar provides an integrated, "big picture" perspective of cost-effective space mission design applicable to commercial, civil, and military professionals. Consistent with meeting mission demands, the course places a substantial emphasis on low-cost missions and current methodologies for reducing cost.

INSTRUCTOR — Dr. James R. Wertz is the President of Microcosm, a space technology development business specializing for more than 20 years in the process of reducing space missions cost. He is co-editor and the principal author of the text used for the course, as well as three other widely used references, *Mission Geometry: Orbit and Constellation Design and Management*, *Reducing Space Mission Cost* and *Spacecraft Attitude Determination and Control*. He holds multiple space system patents, is managing editor of the Space Technology Library, and is an Adjunct Professor of Astronautics at USC. Dr. Wertz has more than 30 years experience in all aspects of mission analysis and design — from concept definition and hardware development to mission operations. He is a Fellow of the American Institute of Aeronautics and Astronautics and the British Interplanetary Society and a member of the International Academy of Astronautics.

PARTICIPANT BACKGROUND — Participants should have an undergraduate degree in engineering or science, or a strong personal or professional interest in space.

COURSE MATERIAL — Each student will receive a copy of *Space Mission Analysis and Design*, 3rd edition, a complete set of the presentation view graphs, and supplementary material.



For more information please contact the Course Administrator, Julie Jackson.

4940 W. 147th Street, Hawthorne, California 90250

Ph: (310) 219-2700 • Fax: (310) 219-2710 • jjackson@microcosminc.com • www.microcosminc.com

SMAD List of Topics

Overview of Space Mission Engineering

- The importance of low cost and robustness in space systems
- Types of space missions
 - Science
 - Military
 - Education
 - Commercial
 - Civil disaster
 - Interplanetary
 - Human spaceflight
- Comparison of NASA, DoD, ESA and Russian processes
- The overall SMAD process
- The FireSat mission

Concept Exploration

- Preliminary design
- Developing operational concepts

Mission Architecture

- Elements of a space mission
- Data flow analysis

Mission Analysis & Mission Utility

- Figures of merit
- Quantifying mission utility

Requirements Definition

- Top-level requirements
- Requirements flow-down

Introduction to Mission Geometry

- Emphasis on processes for evaluating and understanding mission geometry
- Relative and apparent motion of satellites
- What does the spacecraft see?
- Introduction to viewing and lighting conditions

Astrodynamics and Orbit Design

- Introduction to traditional astrodynamics
- Orbit parameters
- Launch windows and timing of launch opportunities
- Earth coverage
- Orbit selection and design
- Types of orbits and trajectories
- Interplanetary orbits
 - 1-way
 - Round trip
- Orbit transfer
- Orbit maneuvers
- End-of-life disposal

Space Environment

- Radiation environment
- Launch environment
- 0-g

Payload Design

- E-M spectrum
- Payload design

Spacecraft Design

- Overall spacecraft configuration
- Bus design

Subsystem Design

- The value of margin — the lessons of smallsats and Amsats
 - What does it take to work in orbit?
- Specific subsystems
 - ADCS
 - Structures/mechanisms
 - Thermal
 - Communications
 - C&DH
 - Power
 - Propulsion
 - GN&C

Launch System Selection

- Note — course does not address launch system design because most space programs can't create their own launch vehicle
- Current and planned vehicles
- Why are launch systems expensive and unreliable
- Launch vehicle selection

Ground Segment and Mission Operations

- The role of autonomy in responsive systems
- Creating operations systems
- Getting data and information rapidly to users

Computer Systems

- Software as a key ingredient of flexibility and responsiveness
- Plug and play — can spacecraft be like PCs?

Reliability and Safety

System Validation and Verification

Low Cost Spacecraft Design

- Can low-cost spacecraft be capable and reliable?

Putting It All Together

- How do we create an environment in which space missions thrive and prosper

"I've been trying to take this course for 3 years. I wasn't disappointed. Excellent overview of the spacecraft design process. Dr. Wertz is an excellent instructor with an encyclopedic space knowledge." — Air Force Research Labs

"I expected a lot and got more!" — Wright Patterson AFB

"Particularly valuable were the many anecdotes by the instructor drawn from real industry experience and current industry contacts." — Wright Patterson AFB

"Excellent speaker with remarkable background depth/breadth; a pleasurable learning experience." — USAF Space and Missile Systems Center (SMC)

"Une bonne vision d'ensemble." — CNES (French Space Agency)

"Stimulating. Makes one compare reality with theory. Very good and well structured lectures; just the right trade-off between detailed and comprehensive." — ESTEC (ESA Space Technology Center)

"Interweaving the talk with participation from the floor was effective." — Open tutorial at USU Small Satellite Conference

"Better than 2 other similar courses I've taken; best systems course I've had; the best, most usable course I've ever taken." — NASA Jet Propulsion Laboratory (JPL)

"Presentation was well thought out and well designed. Practical experience of the presenter stands out; enthusiastic and motivated; Dr. Wertz was easy to listen to and his interest in SMAD is almost infectious." — NASA JPL

"The real-life examples provide a lot of extra detail that provides a deepened understanding of the course notes. You fit the important part of a 4-year aerospace degree into one week. A much broader (and in parts more comprehensive) coverage of SMAD than even what I had in graduate school. If at least some of the practices outlined in this course had been applied to Space Station design, we could have avoided lots of problems." — NASA Johnson Space Center

"The course makes you take a step back and think about how we do things in the space program. I learned a lot. This tutorial is a great motivator." — CSA (Canadian Space Agency)

"Was presented extremely well, with tremendous patience and understanding of the needs of a diverse audience. The presenter was very knowledgeable and enthusiastic about the course so that energy was contagious. It was just great!" — NASA JPL

"The course was outstanding. Material was well prepared, presented interestingly, and very applicable and relevant to the NASA environment. Instructor was clearly outstanding. Finally, I see the big picture!" — NASA Goddard Space Flight Center (GSFC)

"This is the only course I've attended as a government employee which gave me a good perspective on 'the world according to contractors' and I believe this was extremely valuable. It would take me years of talking with colleagues to get the perspective you've packed into the course." — NASA GSFC