Instrument Synthesis & Analysis Laboratory

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Optical Society of America
October 10 - 14, 2004

Acronym List

- AO: Announcement of Opportunity
- CAD: Computer Aided Design
- COBE: Cosmic Background Explorer
- DIRBE: Diffuse Infrared Background Experiment
- DMR: Differential Microwave Radiometers
- EXIST: Energetic X-ray Imaging Survey Telescope
- FIRAS: Far Infrared Absolute Spectrometer
- FTE: Full-Time Equivalent
- GSFC: Goddard Space Flight Center
- GPM: Global Precipitation Measurement
- GEO: Geosynchronous Earth Orbit
- HEO: Highly Elliptical Orbit
- HST: Hubble Space Telescope
- IDC: Integrated Design Capability
- IMDC: Integrated Mission Design Center
- ISAL: Instrument Synthesis & Analysis Laboratory
- JWST: James Webb Space Telescope
- LOE: Level of Effort
- NGST: Next Generation Space Telescope
- SDO: Solar Dynamics Observatory
- STS: Space Transportation System
- TDRSS: Tracking and Data Relay Satellite System
- WFF: Wallops Flight Facility
Introduction

Instrument Synthesis and Analysis Laboratory

• What I am going to talk about:
  - My background in instrument development
  - Historic instruments at Goddard
  - Development of the Integrated Design Capability at Goddard
  - Anatomy of the Instrument Synthesis & Analysis Laboratory

COBE - 1984

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[Diagram of COBE spacecraft]
Why an Integrated Design Capability?

- Previous concept design process:
  - Too many meetings
  - Too many people
  - Too low on the priority totem pole
  - Tied up too many resources
  - Took too long to complete
  - Incomplete collaboration between disciplines
  - Inconsistent or non-convergent results
  - Infrequent interaction with the "customer"

Did not always meet customer needs or expectations

Proven state-of-the-art engineering...

- Reduced cost and schedule for development of end-to-end space mission and remote sensing conceptual designs

  Previous engineering process:
  - Study duration: ~ 6 months
  - Level of effort (LOE): 2.5 FTEs

IDC engineering process:
  - ISAL study duration: 1 - 2 weeks
  - ISAL approx. LOE: ~0.3 FTE

  IMDC study duration: 4 - 5 days
  - IMDC approx. LOE: ~0.3 FTE
Proven state-of-the-art engineering con’t

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- Increased capabilities and improved consistency across studies
- Hands-on involvement of the customer in the design process
  - Customer needs and/or expectations routinely met or exceeded
- Concurrent engineering environment
  - All disciplines working together and all at the same time
  - Consider all aspects of the mission life-cycle at the same time
- Increased and improved collaboration between subsystem disciplines
  - Infuse the end-to-end system perspective into the entire team
  - Improve product consistency, quality and system level convergence
  - Improve technology infusion, especially for cross-discipline items

IDC Competencies - Broad, Diverse, Customer Driven

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- Imagers, Cameras
- Spectrometers
- Lidars
- Gamma-Ray to IR Telescopes
- Solar Physics Instruments, Spectroheliographs
- Passive or Microwave Radiometers
- Optical Molecular Sensors
- Planetary & Lunar Orbiter Instruments
- Large Weather Satellite Instruments
- Geochemistry experiments

Integrated Mission Design Center
- LEO, HEO, GEO, libration orbits, interplanetary and deep space, balloon
- Single spacecraft missions, formation flying, constellations, distributed systems
- Uncontrolled or controlled deorbit and recoverable payload modules
- Expendable vs. non-expendable launch vehicles
Custom vs. commercial spacecraft tradeoffs
Nanosats to large satellites
IDC Strategic Benefits

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• New Business Support
  - First line of engineering analysis for Directorate/Center sanity check
  - First responder team for evaluating and assessing potential GSFC new work
  - In place, efficient as well as flexible, operational design environment to mature design concepts
  - Produce mature design concepts that improve competitive position and provide firm basis for future life cycle activities
  - “Hands on” involvement of the customer in the design process resulting in conceptual designs that better meet customer needs

Strategic Benefits con’t

• Cross life-cycle support
  - Lead trade study execution and/or maturing of design concepts
  - Support Tiger Team and/or Red Team activities
  - Support Confirmation Review preparation and evaluation
  - Support acquisition evaluations
  - Support risk mitigation process

Technology Support
  - Identification and/or evaluation of enabling technologies
  - Mechanism for infusing new technologies into future concepts
  - Technology roadmap development
Why go to the ISAL?

* **Clear Proven Objectives**
* **Successful History**
* **Unprecedented Resources**

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Clear Objectives

* To provide a rapid and sustainable instrument development environment with clear, efficient processes and skilled engineers.
* To provide a capability for quick and efficient trade studies of instrument architectures and concepts.
  - Supports different maturity levels
  - Direct AO response
  - Trade Studies in advance of AO
  - Instrument Incubator Program projects
  - Space Exploration Studies - new NASA Directives
* To streamline and optimize instrument system design for Phase A, including cost, risk and technology assessment.
Successful History

Operational facility since Spring 1999

Completed more than 60 studies since its inception

Experience with Earth Science, Space Science and Space Exploration instrument projects
- Aquarius (Sea Salinity Study) selected for Earth Science
- SDO and GPM have asked for designs
- EXIST selected as part of the decadal plan by the National Academy of Sciences
- NGST (now JWST) early studies done in the ISAL

Unprecedented Resources

Cadre of highly-skilled discipline engineers
- Collaboration of clients, discipline engineers, and scientists to discuss concept viability
- Provide customized level of service
- Detailed designs with significant analysis

State of the Art Facility

Strong Leadership Team
Unified ISAL management and operations with the Integrated Mission Design Center (IMDC) to form the Integrated Design Capability (IDC) in Spring 2001
ISAL Engineering Skills

- Systems
- Science Liaison
- Thermal/Cryogenics
- Optical
- Electro-Optical
- Electronics
- Electro-Mechanical
- Opto-Mechanical
- Mechanical Analysis
- Detectors
- Cost Modeling/grass roots
- Laser Technology
- Microwave Technology
- Flight Software
- Orbital Debris
- Mission Success/Risk

ISAL Sample Product
Structural Analysis

Analysis Process & Products