Comet and MSC Nastran use a functional modeling approach to unify multiple engineering disciplines and physics domains. The long desired goal of simulation-driven design has been to enable engineering analysts to focus on achieving the product’s functional requirements starting early in the R&D cycle. By putting simulation analysts in control of the “engineering geometry” starting at the conceptual design stage, reusing CAE best practices, and automating highly manual and repetitive design simulation tasks, performance simulation results can finally drive critical new product development decisions.

Do More Early Conceptual Analysis at Higher Quality, Faster

Developing a new infrared (IR) telescope design required the collective experience and technical knowledge of multiple engineering teams working collaboratively in The Aerospace Corporation’s Concept Design Center (CDC) – the Electro-Optical Payload Team (EOPT) and the Space Segment Team (SST). The EOPT, an interdisciplinary team of engineers (mechanical, structural, thermal, optical, and controls) is dedicated to the detailed design of Electro-Optical (EO) sensor payloads. The SST focuses on the space vehicle (satellite bus) design.

MSC Software: Partner Showcase - Comet Solutions Inc.
Rapid Concept Engineering

Comet Solutions Inc., an MSC Software Community Partner, develops and implements Comet®, an integrated modeling and simulation process automation environment that enables rapid conceptual engineering. Comet provides robust integrations with the MSC Nastran™ and Adams™ solutions, as well as other commercial 3-D CAD and CAE software tools.

Key Highlights:

- **Industry**: Aerospace
- **Challenge**: To develop a new infrared (IR) telescope design.
- **MSC Software Solutions**: MSC Nastran to perform various structural analysis of the structural model.
- **Benefits**:
  - Accelerate design and analysis
  - Reduce errors early in design process
The IR sensor engineering activity began with the development of a concept design for the telescope optics (Figure 1). The sensor design is typically done separately by an optics system engineer in an optics design tool such as CODE V, which creates a non-geometric description of the sequential optical path that light travels within the telescope as it reacts with the various optics components—mirrors, beam splitters, collectors, etc.

A second source of conceptual design data is the 3-D geometry, which is imported into Comet from the CAD system in the form of a functionally “tagged” 3-D geometric description containing the various telescope components (Figure 2).

These two elements of the telescope design are “married” within the unique Comet Abstract Engineering Model® into a single, multi-fidelity functional model of the telescope, which captures all of the properties required to predict the overall performance of the optics system as attached to the satellite bus operating in various environments or duty cycle conditions (such as mechanical/structural loads due to launch, thermally induced deformations and stresses while the satellite is operating in space).

The Structural/Thermal/Optics Performance (STOP) simulation process (Figure 3) was defined in the Comet Workspace to evaluate the effects of the various duty cycle environments on the optical performance of the IR telescope (such as image quality). In the overall process schematic, there are tasks dealing with automating the meshing of components for both the structural and thermal models; the thermal analysis is then performed with Thermal Desktop using the orbital temperature profile, and thermal results are transferred automatically to the structural model where various structural analyses are performed using MSC Nastran. The Sigmadyne SigFit software is used as a bridge between the thermal finite element calculations and the structural finite element calculations and the Synopsys CODE V optics model. Because these templates are defined in functional terms, not specific to any one geometric instance of the design, engineers can use the Comet templates to evaluate

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“The same integrated model was iterated to correct detailed design problems while easily assessing the impacts of those design changes on all aspects of systems performance.”

Dr. David Thomas, The Aerospace Corporation

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Figure 1: IR Telescope CODE V Optics Design
Figure 2: IR Telescope 3-D CAD Design Concept
substantially different geometric and topological design concept alternatives. Once the Simulation Process for STOP analysis is set up, the effects of concept design changes or different thermal environments on optical performance can be re-evaluated in one day or less, even for complex opto-mechanical designs—with far less delays and human errors at the points where information is exchanged manually between the various disciplines.

As Dr. David Thomas (Engineering Team Lead, The Aerospace Corporation) commented, “The Comet-enabled integrated STOP process allowed our interdisciplinary engineering team to conduct an analysis that normally takes several days or weeks to perform to be completed in a single day. These savings are realized for each design cycle in the iterative process needed to converge to a satisfactory overall design for the IR telescope.”

The Comet Project Dashboard (shown in Figure 3) provides a summary view of the key inputs (variables) and key outputs (metrics) compared to the required performance specs of the product (requirements). Project data is always up to date and readily accessible from the workspace interface—replacing what are typically static data presentations using Word, PowerPoint, etc. Working from the Project Dashboard, analysts can modify the values of the key system variables to perform design trade studies and easily rerun “approved” simulation templates across one or more application domains—and the Dashboard is automatically updated with the new results. Engineering/Program managers and systems engineers can also review the state of the design and compare designs easily across different variations of the model—with a complete history of all the design configurations and variants that have been performed within the Comet Project (also shown in Figure 3).

**Summary**

Using Comet, combined with MSC Software tools to perform integrated modeling and process automation for standard, well-defined and repeatable design simulation activities, engineering analysts and project teams can accelerate the design and analysis of complex, high-performance systems by being able to:

- Capture/reuse engineering best practices of domain analysts
- Perform more robust mixed-fidelity trade studies starting early in the design cycle
- Reduce manual rework and errors
- Collaborate across the project team
- Make decisions based on consistent design data and simulation results (i.e., all disciplines work off the same pedigreed data)
- Produce an audit trail of project processes, assumptions, models, and results

For additional information on the Comet software and other industry applications, or to download a SPIE technical paper and conference presentation on this Aerospace Corporation project, visit [www.cometsolutions.com](http://www.cometsolutions.com).

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**Figure 3:** IR Telescope Project Results in the Comet Engineering Workspace
About MSC Software

MSC Software is the worldwide leader of multidiscipline simulation solutions that help companies improve quality, save time and reduce costs associated with designing and testing manufactured products. MSC Software works with thousands of companies worldwide to develop better products faster with simulation technology, software, and services. MSC Software is a global company with offices in 20 countries. For additional information about MSC Software’s products and services, please visit www.mscsoftware.com.

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About MSC Nastran

Accurate, Efficient & Affordable Finite Element Analysis

MSC Nastran is the world’s most widely used Finite Element Analysis (FEA) solver. When it comes to simulating stress, dynamics, or vibration of real-world, complex systems, MSC Nastran is still the best and most trusted software in the world – period. Today, manufacturers of everything from parts to complex assemblies are choosing the FEA solver that is reliable and accurate enough to be certified by the FAA and other regulatory agencies.

Engineers and analysts tasked with virtual prototyping are challenged to produce results fast enough to impact design decisions, and accurate enough to give their companies and management the confidence to replace physical prototypes. In today’s world, nobody has time or budget to spend evaluating the accuracy of their FEA software – you need to know it’s right.

MSC Nastran is built on work done by NASA scientists and researchers, and is trusted to design mission critical systems in every industry. Nearly every spacecraft, aircraft, and vehicle designed in the last 40 years has been analyzed using MSC Nastran. In recent years, we’ve applied some of the best and brightest scientists in CAE to extend MSC Nastran’s power and efficiency, resulting in its continued status as the world’s best, most trusted, and most widely used FEA software – period. New modular packaging that enable you to get only what you need makes it more affordable to own Nastran than ever.

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