



# EADS CASA ESPACIO Successfully Implements VA One for Full-Frequency Vibro-Acoustic Analysis of Spacecraft

## THE CHALLENGE

- Design advanced composite satellite structures that are lightweight but that can also withstand the harsh acoustic environments encountered during launch.
- Assess the transmission of acoustically induced vibration into attached equipment to determine equipment qualification levels.
- Model the response of large complex systems subjected to random vibro-acoustic loading across a broad frequency range.

## THE BENEFITS

- Dynamic stress prediction guides the design of critical components subjected to random vibro-acoustic loads.
- Unique combination of low, mid and high frequency analysis methods in one tool results in faster model creation and simplified model management.
- Customization through scripting to integrate with existing in-house methods for strength calculation.
- A structural engineer with one year of experience can be productive with the software after only a minimal amount of in-house training.

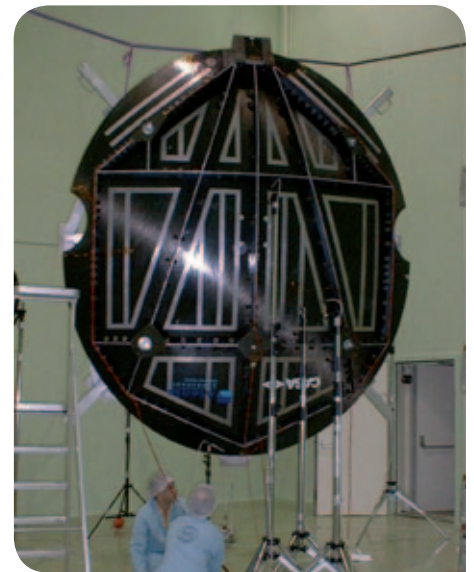
EADS Astrium is a world leader in the design and manufacture of satellite systems, payloads, ground infrastructure and space equipment for a wide range of civil and military applications. The company is a world class specialist in Earth observation and meteorological systems, offering platforms, optical and radar instruments and ground segment equipment. EADS Astrium is a prime contractor to the European Space Agency for its major space exploration programs. EADS CASA Espacio is integrated within EADS Astrium and since 1966 has developed, produced, integrated and qualified space systems, instruments and subsystems for launchers and satellites. The company is a European Center of Excellence in Composites and is widely recognized as a leader in the design and manufacture of advanced composite structures for space applications.

## Vibro-Acoustics

Satellite systems often employ advanced composite structures and contain sensitive equipment. The structures are designed to be lightweight to reduce payload costs but must also withstand the extremely high acoustic and vibration environments encountered during launch. The random broadband acoustic environment below 350Hz is often one of the primary design loads for lightweight components such as large antennas. Vibro-acoustic analysis is therefore extremely important in the design of satellite structures.

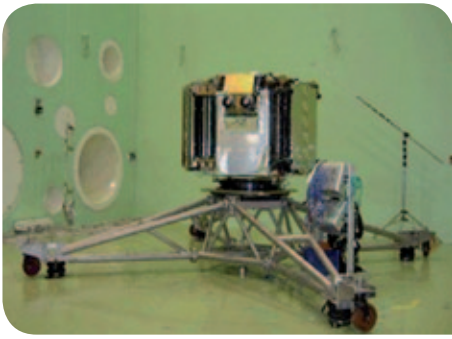
*“VA One meets our needs for the vibro-acoustic analysis of spacecraft across the entire frequency range. With a single tool we can account for all the vibro-acoustic loads on our satellites”*

Mr. José Luis Riobóo,  
Responsible for Engineering Organization  
at EADS CASA ESPACIO.



Acoustic testing of an antenna  
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The equipment within a satellite is also sensitive to vibration. The panels on which the equipment is mounted are often excited by the high acoustic levels experienced during launch and this causes the panels to vibrate. This vibration is then transmitted through the mounting interfaces to

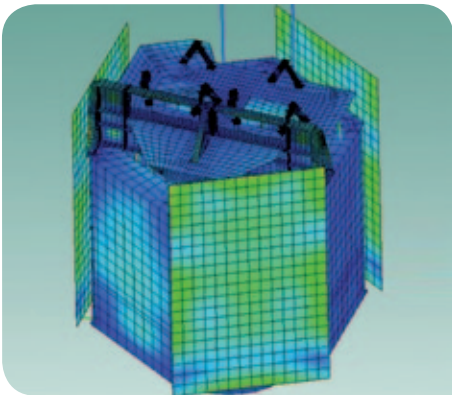


Acoustic testing of a satellite structure  
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the equipment itself. The equipment is sensitive to broadband random vibration below 2kHz. To ensure that a given piece of equipment can be safely flown it must be qualified to meet an expected vibration environment. Vibro-Acoustic analysis is therefore also very important for the derivation of qualification levels for equipment within satellite structures.

## Improved Productivity

EADS CASA Espacio has been performing vibro-acoustic analysis for over twenty years. Initial analysis methods focused on



VA One model of Spacecraft  
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approximate procedures such as equivalent quasi-static accelerations or uncoupled random loads. However, to quantify the loads on lightweight designs it became clear that more accurate analysis methods were needed. Coupled Finite Element and Boundary Element methods were therefore introduced in 1995. EADS CASA Espacio was looking for ways to further improve their low frequency analysis methods and, in particular, ways to improve productivity and solution times. They therefore introduced VA One for coupled Finite Element and Boundary Element Analysis two years ago. Through the use of VA One, the time for a standard vibro-acoustic design cycle has been reduced by between 30-50%. The time required to set up the model and to postprocess results has also been reduced. Because of the ease-of-use of the software and through established in-house analysis procedures and training, a structural engineer with one year of experience can use the software without requiring dedicated support.

## Enhanced Analysis Capabilities

When EADS CASA ESPACIO acquired responsibility as the prime contractor for complete satellite systems they needed to expand their analysis capabilities to include the definition of random loads for qualification of equipment. This loading mainly arises from the acoustic environment up to a frequency range of 2kHz and cannot be addressed using low frequency methods alone. By using

the Statistical Energy Analysis (SEA) functionality within VA One, EADS CASA was able to expand their analysis capabilities to also include qualification of environments for equipment. The Hybrid FE-SEA functionality within VA One has also been successfully used for analyzing large models of complete satellites at mid-frequencies. The ease with which VA One can be customized through scripting has also proven useful. The export of elemental forces and stresses from VA One ensured that EADS CASA Espacio could combine VA One with their existing in-house strength calculation procedures in order to calculate the margins of safety needed for structural design.

## The Conclusion

By introducing VA One, EADS CASA ESPACIO has improved their productivity and expanded their analysis capabilities to cover the entire frequency range of interest. "VA One meets all of our current requirements for vibro-acoustic analysis of spacecraft, antenna reflectors and equipment. The software provides valuable analytical predictions that we have validated against test", concluded José Luis Riobóo, EADS CASA ESPACIO.

To find out more about ESI's vibro acoustics solution, please visit: [www.esi-group.com/vibro-acoustics](http://www.esi-group.com/vibro-acoustics)

## ABOUT ESI GROUP



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