

Company Presentation



FACTS & FIGURES

**SPACE
HIGH-TECH
BIG SCIENCE
DEFENCE**

40 YEARS IN BUSINESS



300+ STAFF



€ 3,9 M EBITDA



€38,4 M NET SALES



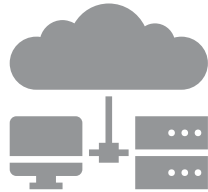
OUR BUSINESS LINES & KEY COMPETENCES



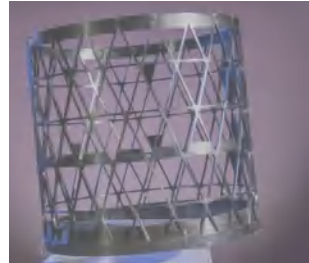
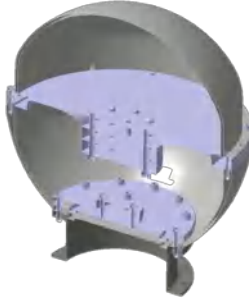
**Professional
Consultancy**



**IT
Services**



ATG Engineering



**Loan
Employment**

**Consulting
Services**

**Managed
Services**

EngineeringLab
Product
Development
-
Engineering &
Review services

CompositesLab
Lightweight,
cost-effective
composite
structures;
ATG-patented

VirtualLab
Engineering and
Communication
tools, based on
VR & AR
technology

MediaLab
Stunning
2D & 3D
visualisations;
stills & movies

On-Site at customer premises

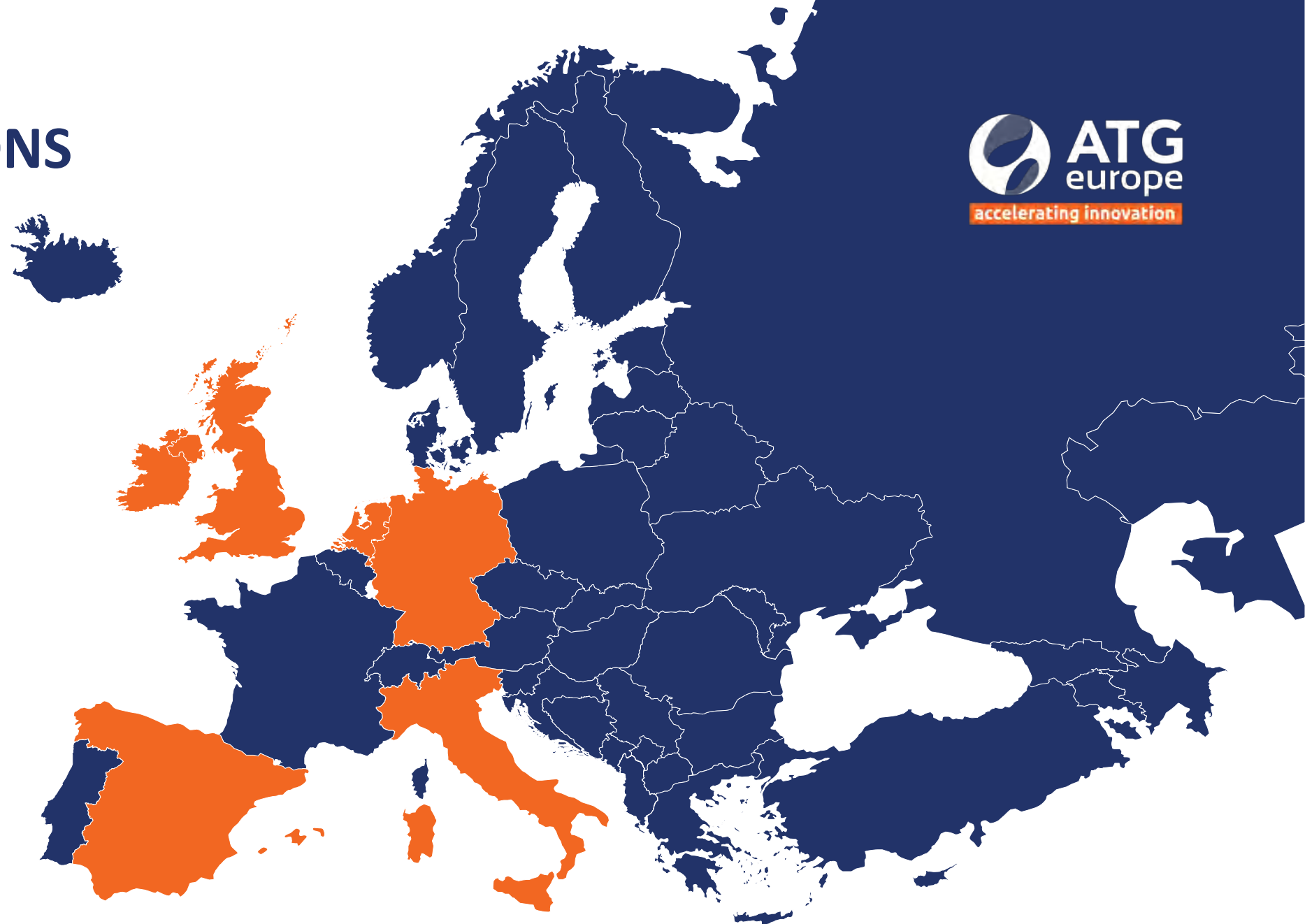
From ATG premises, or on-site at customer

OUR LOCATIONS



11 Countries
20 Locations
6 Companies

- NL
- DE
- IR
- IT
- ES
- UK



OUR BUSINESS MODELS

How would you like
to work with us?



ATG has extensive experience in transitioning between business models, having successfully migrated *on-site consultancy support activities* to both *On-site* and *Off-site Work Packages / Services*.

OUR CUSTOMERS



KONGSBERG

EUMETSAT

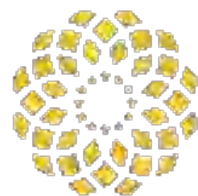


TNO innovation
for life



EUROCONTROL

ASML



**FUSION
FOR
ENERGY**

sck cen



ATG CONSULTING SERVICES



ATG CONSULTING SERVICES – A SUCCESS STORY



ATG CONSULTING SERVICES (WAS BRIGHTEST MINDS) SPECIALIZES IN THE PROVISIONING OF HIGHLY EDUCATED ENGINEERING PROFESSIONALS & SCIENTIST CONSULTANTS.

- A dedicated recruitment team with deep knowledge of the domains in which ATG operates; Aerospace, Big Science & Nuclear and other High-Tech as well as IT services
- Thorough understanding of technical requirements for engineering and scientific projects;
- 50 years' experience in sourcing and selecting engineering and academic experts throughout Europe;
- Extensive network with professionals and universities globally

ATG ENGINEERING

ATG's in house R&D and engineering solutions consisting of 4 individual labs:

- **EngineeringLab**
- **CompositeLab**
- **MediaLab**
- **VirtualLab**



ATG ENGINEERGLAB

THE ENGINEERGLAB IS FOCUSED ON STRUCTURAL AND THERMAL PRODUCT DEVELOPMENT AND ENGINEERING SERVICES.

MARKETS: Space, Aviation, High-Tech, Machine

DISCIPLINES: Thermal, Mechanical, Thermo-Elastic

APPLICATIONS (Space): Entire SpaceCraft, Instruments, Mechanisms, (Electronic) Units, Structures and Thermal Control systems



SPACE ENGINEERING PORTFOLIO

Thermal design, analysis, testing and realisation

(using ESATAN-TMS, custom in-house tools)

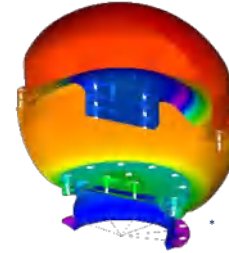
- Satellite bus, payload and components
- Coating, Heater, Radiator and MLI design
- Full lifetime / orbital analysis and optimisation
- Model reduction, model correlation
- Thermal hardware specification, drawing, procurement and inspection
- Thermal Balance / Cycling test execution or support



Structural design, analysis, testing and realisation

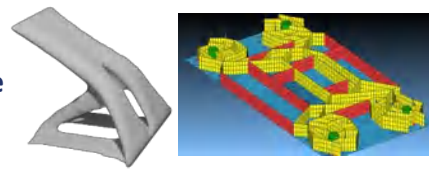
(using FEMAP+ (Msc or NX) Nastran, VA-One, SINAS, custom in-house tools)

- Static & Dynamic loads (Sine, Random, Vibro-Acoustics)
- Buckling & modal assessment and optimisation
- Thermo-elastic + enforced displacements
- Bolted joint modelling, analysis & optimisation
- Model reduction , model correlation
- CAD design, GD&T, manufacturing drawing, manufacturing and inspection management
- Structural test support, evaluation (static and dynamic)



Multi-disciplinary Design Optimisation

- Design for performance & MAIT for multiple drivers: **Structural, Thermal and Thermo-Elastic**
- Human/manual design and optimisation competence from **decades of experience**
- As well as formal computational **topology, shape and size optimisation**
- Expert design and optimisation of **(payload) structures, flexures, radiators, thermal control products, unit boxes** etc



System Engineering on S/C & P/L products, & Omni-disciplinary Satellite / Mission Reviews

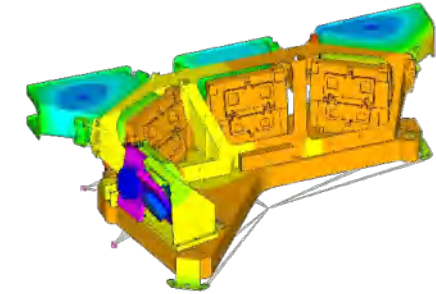
- Overall Design, Development and Verification Planning
- Requirements definition, analysis & optimisation
- Margin philosophy establishment
- Model philosophy establishment
- Verification method trade-off (analysis, testing)
- ECSS compliant reporting
- Milestone review execution / support



EXAMPLES – SPACE THERMAL ENGINEERING

PROBA-V Vegetation Instrument

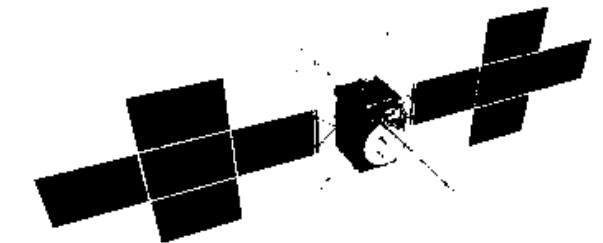
- Operational since dec 2013 (2nd Vega launch): ATG involved from initial stages up to launch
- Multi-spectral payload, 3 cameras: BLUE, RED, NIR, and SWIR
- Thermal concept design and detailed analysis + Thermo elastic analyses
- Thermal Test support and Correlation



PROBA-V payload: image credit OIP NV

Small satellite Thermal Control System sizing and verification

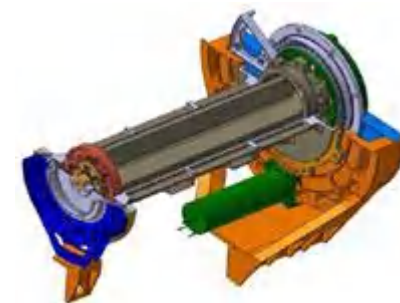
- Thermal control system lay-out: passive (blankets, coatings) and active means (heaters)
- Verification of all orbital operational and non-operational scenario's --> iterative sizing
- Test plan co-engineering and post-test model correlation
- Successfully operating in orbit since 2020



JUICE SpaceCraft. Image credit: ESA / ATG MediaLab

Solar Array Drive Mechanisms & Antenna Pointing Mechanisms

- Thermal engineering partner for Kongsberg's Space Mechanisms since 2013, including special thermal engineering for the JUICE SpaceCraft SADM
- Design, modelling, analysis, optimisation, manufacturing definition and testing of several mechanisms: thermal survival, mechanical strength, pointing accuracy and power efficiency attention points

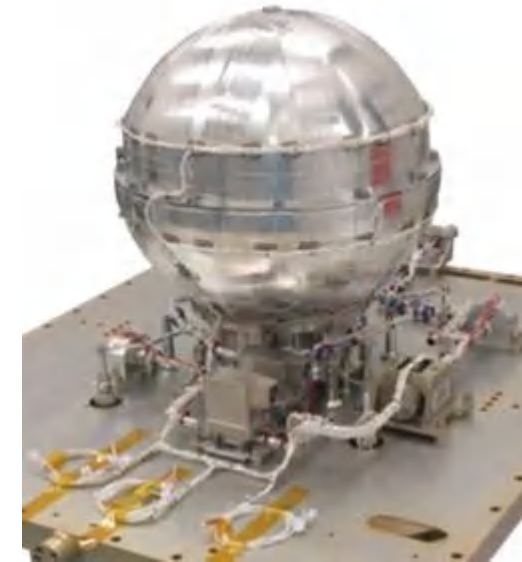
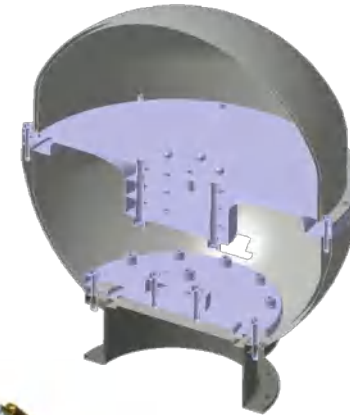


SADM, picture reproduced from:
THE DESIGN, DEVELOPMENT, QUALIFICATION AND DELIVERY OF THE SOLAR
ARRAY DRIVE ASSEMBLY (SADA) FOR BEPICOLOMBO MERCURY
TRANSFER MODULE (MTM)
by Jostein Ekre(1), Johan A. Mürer(1) and Mickael Miller(2)

EXAMPLES – SPACE STRUCTURAL ENGINEERING

P200 Tank STM Development

- Conceptual and detailed design of Tank STM with modular parts for SM and TM
- Manufacturing outsourcing and management, inspection, assembly, packaging and delivery to customer as hardware system

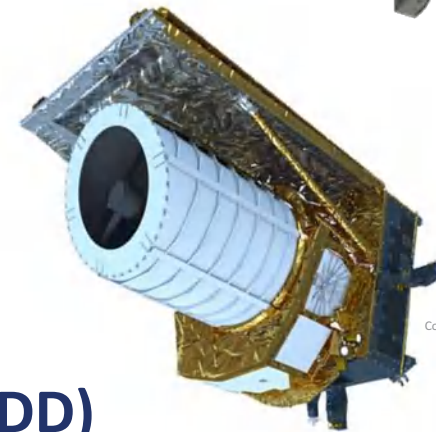


ATG Tank STM *Integrated into propulsion system STM by customer Bradford Engineering.

* The Tank STM design shown in this image was developed under a programme of and funded by the European Space Agency. The view expressed herein can in no way be taken to reflect the official opinion of the European Space Agency

EUCLID – PLM External Baffle

- Consultancy and Work Packages on design and analysis in phase B, C/D
- Structural design and analysis (incl. challenging Thermo-Elastic mounts)
- Thermal design and analysis for cryogenic conditions
- Vibro-Acoustic FEM-BEM analysis of the baffle



EUCLID Spacecraft:
Copyright ESA/ATG Medialab

ExoMars 2020 - Parachute Deployment Device (PDD)

- Initial and detailed structural design and verification, in phases B, C and D
- Manufacturing readiness design in collaboration with manufacturers and drawings creation
- MGSE design including drawings, and MGSE manufacturing and delivery
- Vibration tests and Functional deployment tests participation and post-correlation




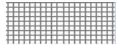
ExoMars Rover. Image credit: ESA / ATG Medialab

THERMO-ELASTIC NICHE EXPERTISE



NEED: Fast and Accurate TE distortion & stress prediction for high-precision instruments

CHALLENGES:

Coarse thermal models (**FDM**)  vs.  **Fine** structural models (**FEM**)
Expensive Structural – Thermal – Optical (STOP) design iteration cycles

SOLUTION:

Extensive know-how of physics and design principles

Experts in modelling practices; setting the new standards

Specialised analysis software (Public agency-approved as well as custom in-house tools)

Efficient Thermal<->Structural workflow optimisation & automation

RESULT:

Accurate thermal conductivity

Accurate temperature mapping

Accurate distortion prediction

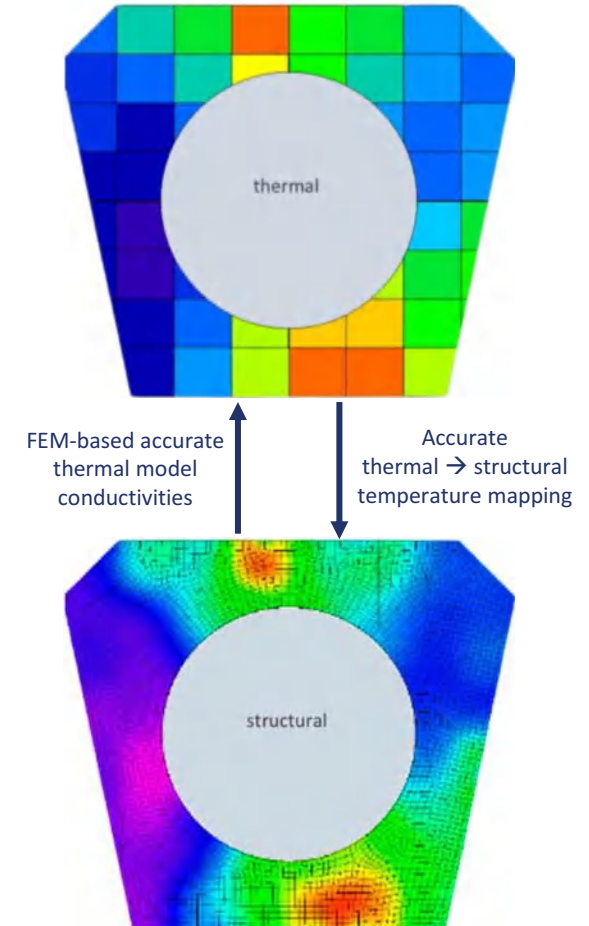
Realistic stress prediction

Near-effortless STOP design iterations (<1 day)

when updating thermal design (no need for full STOP re-run)

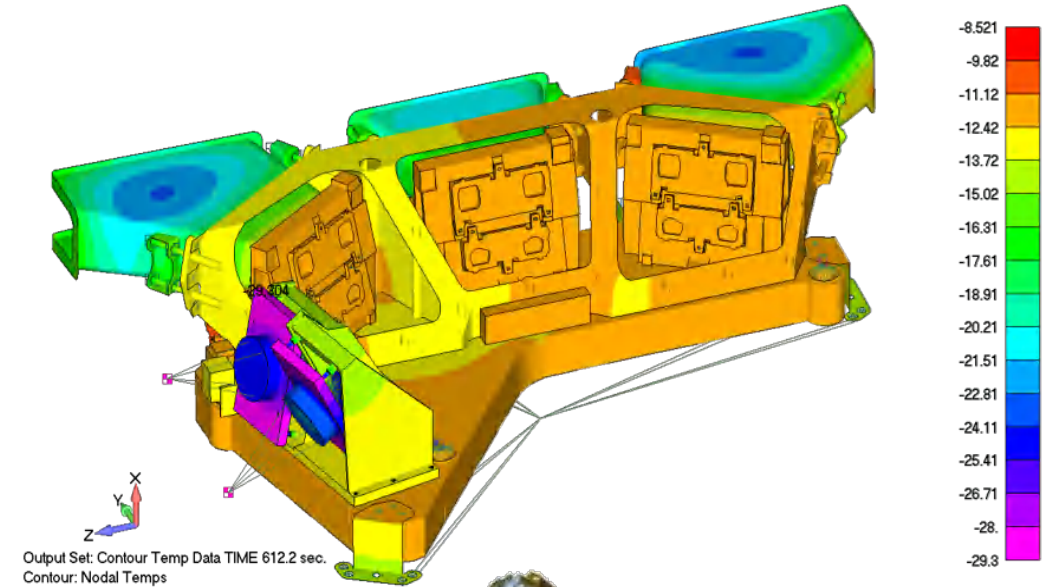
Intuitive identification of Thermo-Elastic performance drivers

Failure prevention in test and operation



EXAMPLE PROJECTS

- Various optical instruments;
 - Earth observations, atmospheric measurements
 - Lunar landing autonomous navigation system
 - Laser optics (altimeter, communication)
- Structures/units
 - Large scale structure, e.g. Euclid Baffle
 - Thermally critical electronic boxes
- R&D and publications
 - European Guidelines Project for TE verification
 - Support to ESA on PySINAS TE Overlay and Mapping software
 - Extensive internal R&D on sample components and methodologies



EUCLID Spacecraft:
Copyright ESA/ATG Medialab

OUR APPROACH: TE-CLASSIFICATION

- Identifying key drivers and TE disturbance sources
 - As an early phase design tool
 - For detailed numerical verification in later phases
- Efficient iterations;
 - Direct assessment of optical performance
 - Through representative measures (e.g. rotation of instrument interface)
 - By integration optical transfer matrix (e.g. Line of Sight)
 - No need to-reperform FE analysis for updates in thermal model
 - Efficient sizing of dedicated TCS
- High accuracy thermal mapping of temperatures from thermal model to structural model using dedicated agency-approved software
- Tailored solutions for your specific problem

$$\{\delta_{optical}\} = \begin{bmatrix} TE \\ Transfer \\ Matrix \end{bmatrix} \{T_{Thermal Node} - 20.0\}$$

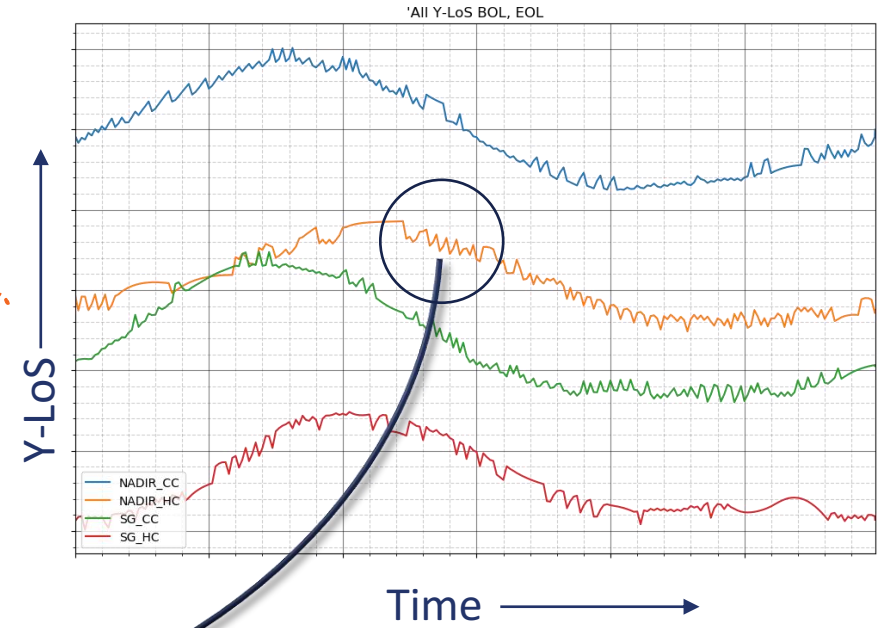
*Provided by our
thermal and
mechanical engineers*

$$\begin{bmatrix} x_{LoS} \\ y_{LoS} \end{bmatrix} = \begin{bmatrix} Optical \\ Transfer \\ Matrix \end{bmatrix} \{\delta_{optical}\}$$

*Provided by your
optical expert*

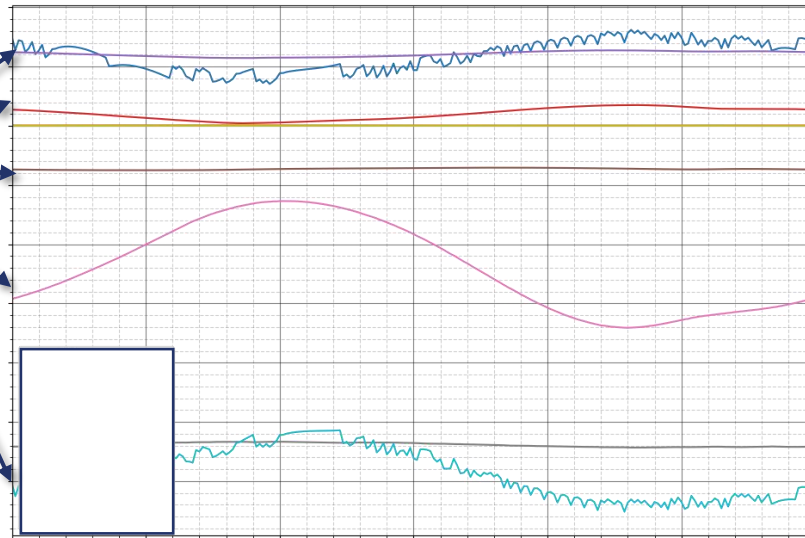
EXAMPLE: INTEGRATED TE-LOS ASSESSMENT FOR EARTH OBSERVATION INSTRUMENT

Efficient numerical assessment of multiple orbits, thermal cases, etc.



Detailed insight in individual orbits

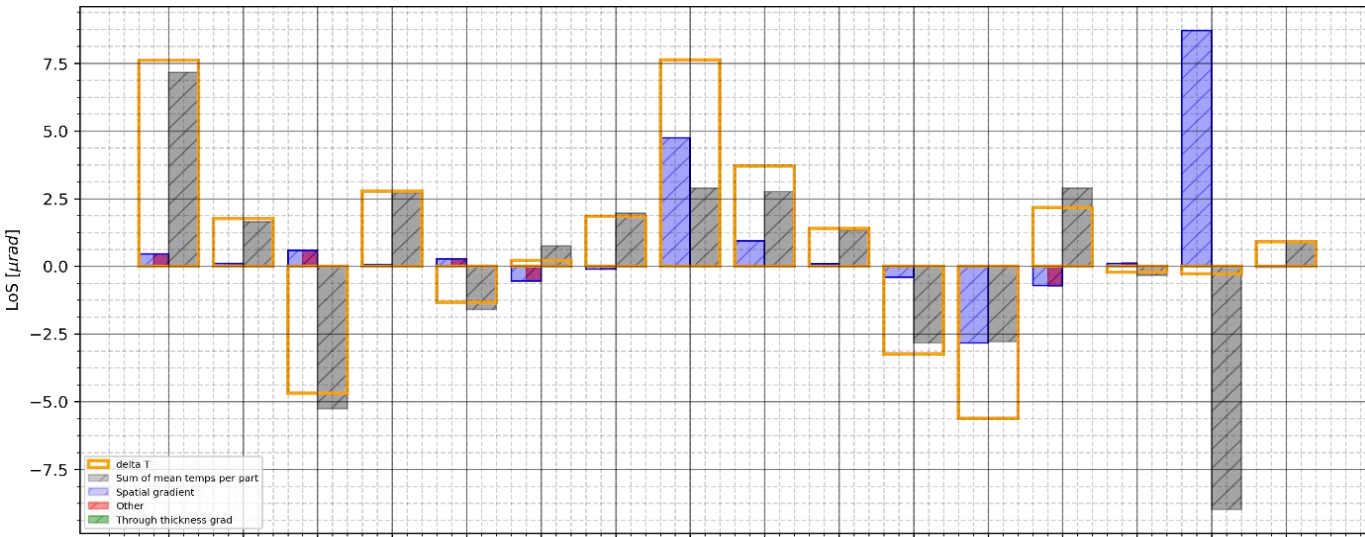
'NADIR HC' Y-LoS contributors



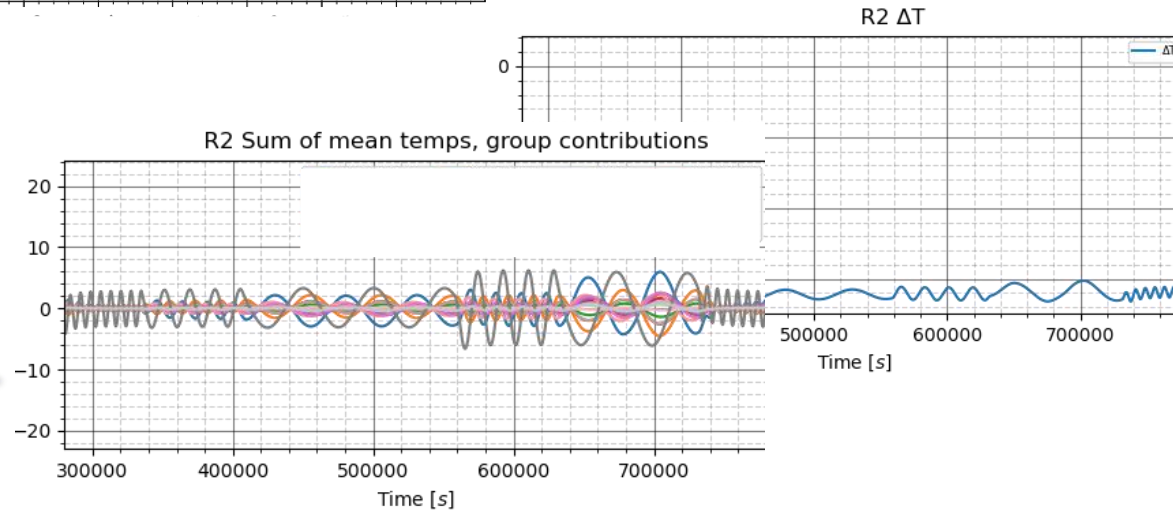
Time →

LoS contribution by different subsystems or components in the evolution

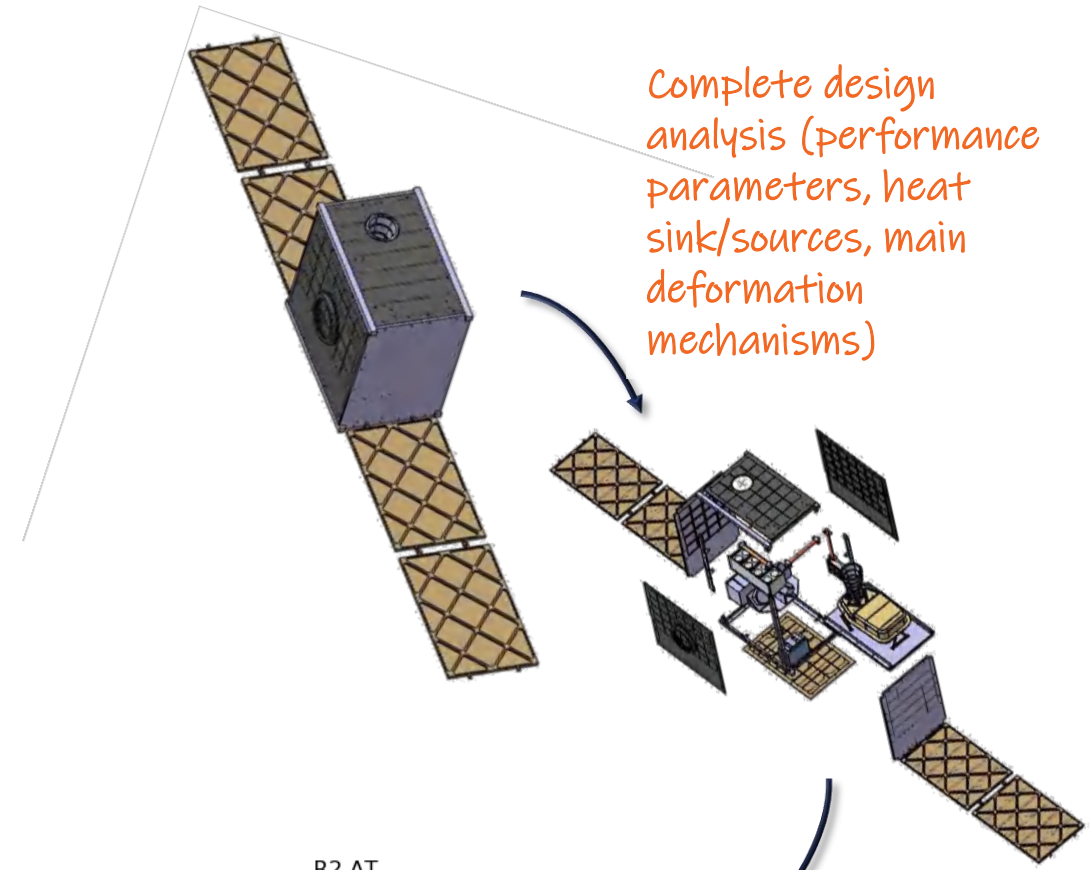
EXAMPLE ESA PROJECT: EUROPEAN METHODS FOR TE VERIFICATION



Intuitive overview per subsystem. Identification of design/modelling updates required



Detailed analysis on distortions transient evolution and their main contributors



TECHNICAL REVIEWS

End-to-end technical review of space systems

- Covering subsystems, systems, projects, programs (single components, instruments, spacecrafts, constellations).
- According to applicable standards (ECSS, CCSDS, ISO, etc.) and space industry's best practices.
- Tailoring based on stakeholders' inputs (business case, project phase, etc.).
- Fully (vendor/LSI) independent company (same applies to network of partner companies).
- 40+ years of engineering consultancy to ESA and other space industry.
- Full protection for customers' data (Secret level security cleared facility, dedicated IT infrastructure).

Highly experienced and skilled review teams

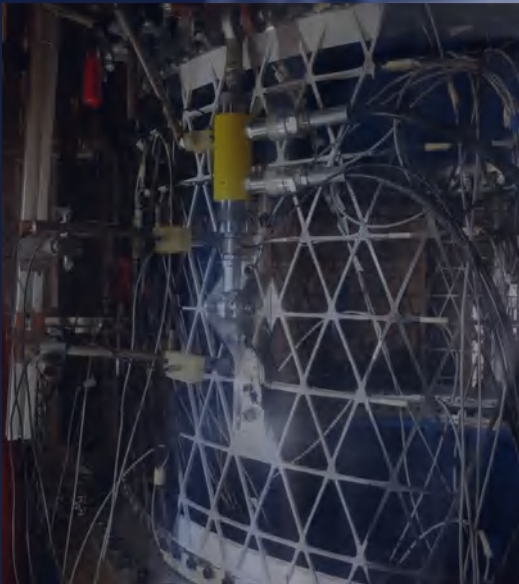
EngineeringLab combines its Systems Engineering, Thermal, Structural and Thermo-Elastic core competences with the broader ATG workforce of 200+ engineers and specialists covering almost each technical domain; providing omni-disciplinary Reviews covering entire Missions and Spacecraft

- Efficient collaboration with staff across all ATG Business Units
- Network of senior and highly experienced space programs and project managers (ex-agencies and industry senior managers).
- Extensive network of partner companies for specific additional expertise.



COMPOSITESLAB

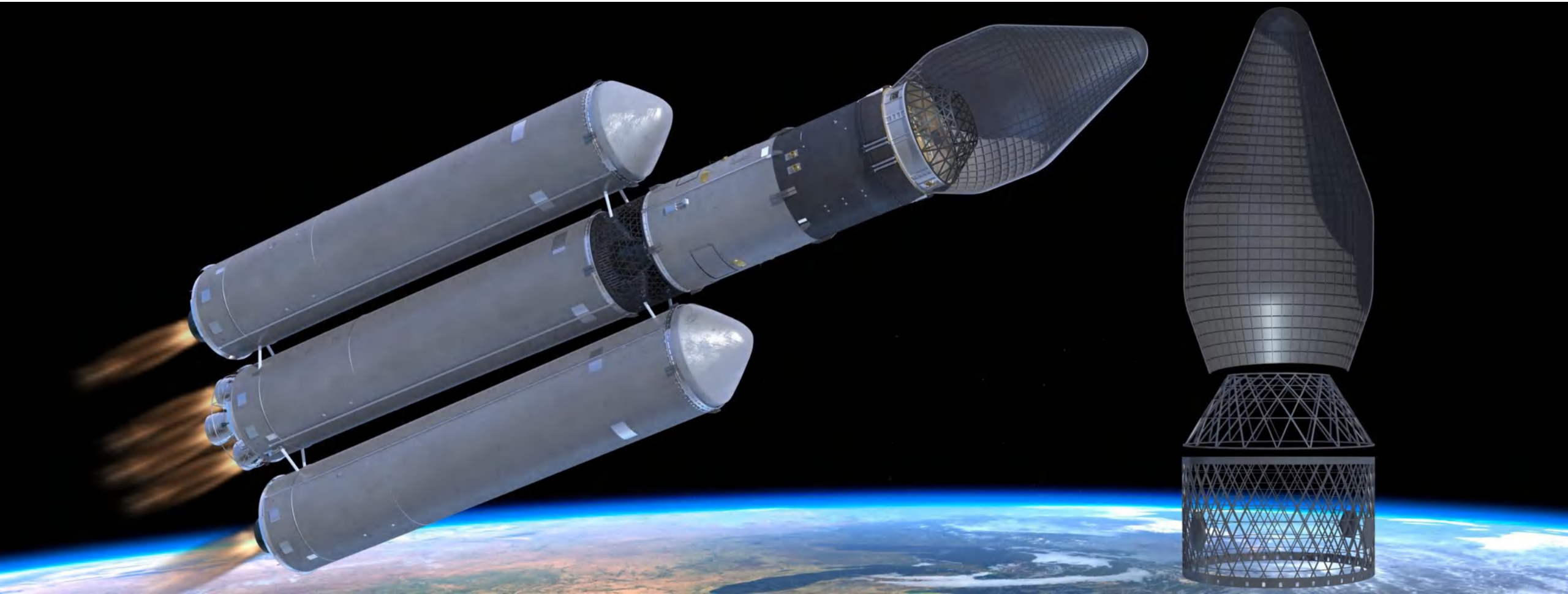
CompositesLab has developed a patented unique lightweight and cost-effective grid-stiffened lattice composite structure technology, which is currently under further development for among others a spacecraft central tube and an inter-tank structure for a launcher



ATG PROPRIETARY COMPOSITE TECHNOLOGY



FIBRE PLACED PRE-PREG LATTICE STRUCTURES FOR SPACE APPLICATIONS

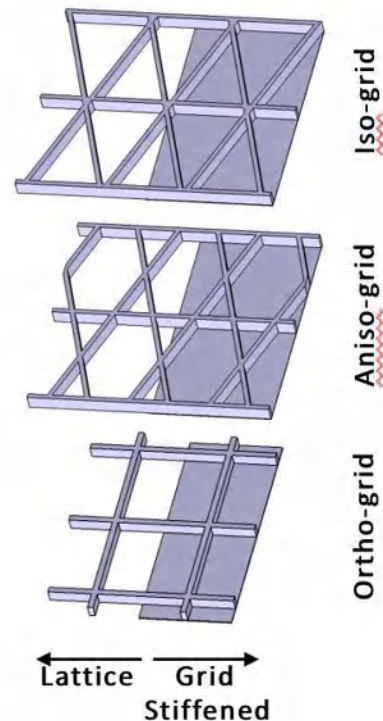


LATTICE STRUCTURE BASICS

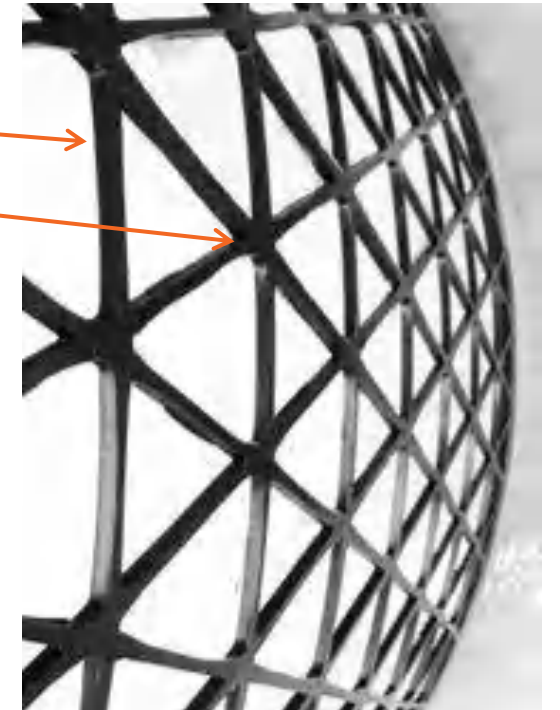
- Lattice structures ideal for global & local load paths
- CFRP strong/stiff in fibre direction



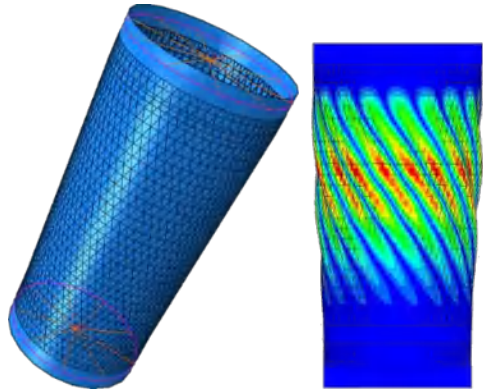
Composite lattice structures combine both into an optimal structural concept



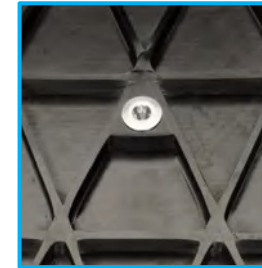
- Ribs built of uni-directional fibres
- Fibres uninterrupted at the node
- Fully integrated attachment patches and laminate transition zones
- Many configurations, for any load or environment:
 - Lattice structures; ribs only
 - Grid-Stiffened skin structure; ribs + skin
- Lattice structures combine the advantages of metal 3D-printing with the unidirectional performance of CFRP
- Entire CFRP structure is made in a one-shot process



ATG COMPOSITE TECHNOLOGY



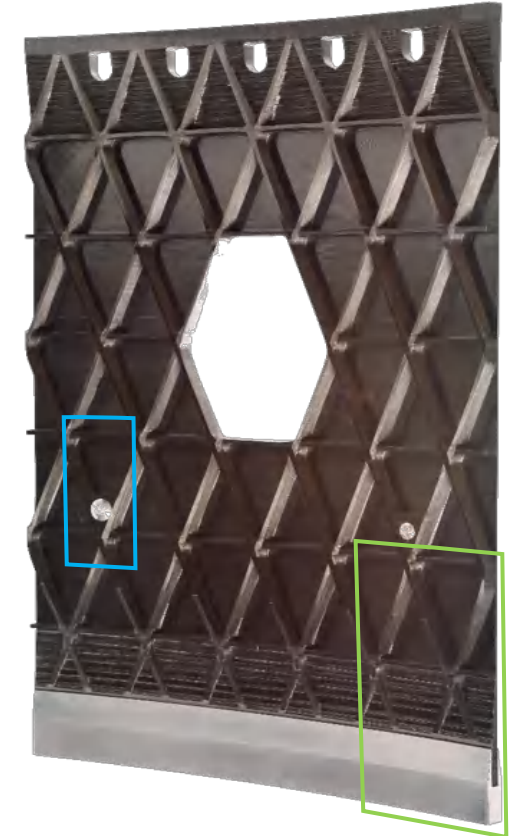
ATG Europe Grid-Stiffened Cylindrical Demonstrator, 2018



On-node in-panel attachment



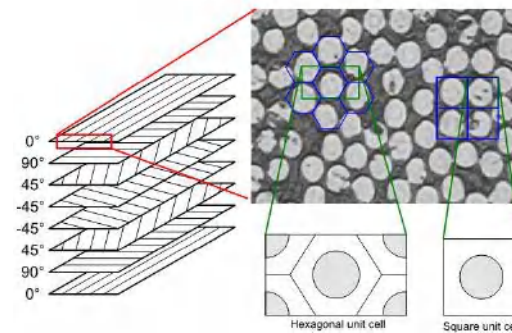
End-of-panel composite/metallic interface attachment



ATG Europe Grid-Stiffened Demonstrator Panel, 2015



Subset of test specimens proven for strength and stiffness



BACKGROUND AND CHARACTERISTICS



ATG's proprietary and patented technology has been designed to achieve higher performances and reduced cost of manufacturing compared to competing technologies for specific applications.



- Reduction of between 20% and 60% of mass, and beyond for specific applications
- Pre-preg material with uninterrupted fibres at the nodes (~60% volume fraction)



- One-shot manufacturing process: all features are integrated in one go, no need for subsequent manufacturing steps.
- Possibility to reposition attachment points up to days prior to manufacturing, without the need for an extensive manufacturing preparation cycle



- Reduction of up to 30% of manufacturing costs if smartly manufactured

COMPOSITESLAB – MAKE OR BUY

ATG delivers both Make & Buy solutions for its grid-stiffened/lattice structures:

MAKE

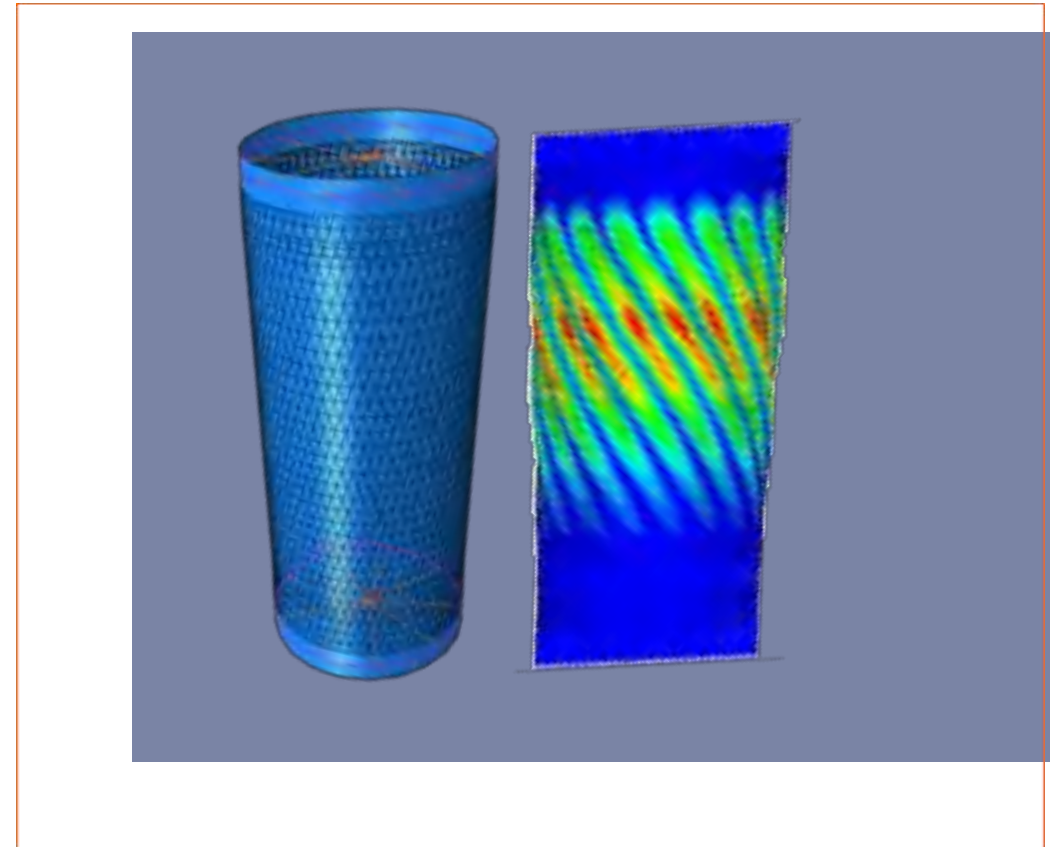


- Licensing of proprietary technology for design and manufacturing
- Knowledge transfer to ensure autonomous design and manufacturing capabilities
- Engineering support available from ATG for design and manufacturing

BUY



- ATG has partners experienced in the manufacturing of our technologies
- Sourcing from multiple EU countries available
- Several geo-returns can apply both for design and manufacturing of the procured items



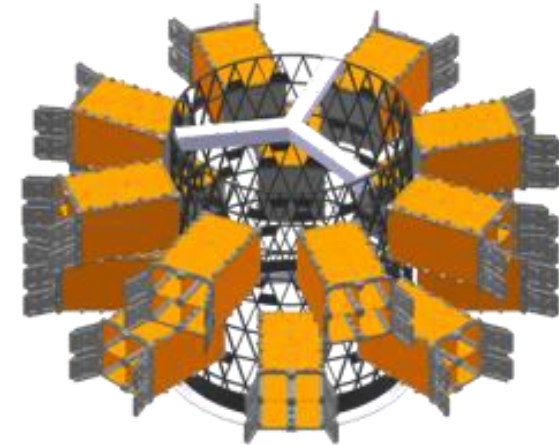
OUR TECHNOLOGY - SUITABLE APPLICATIONS



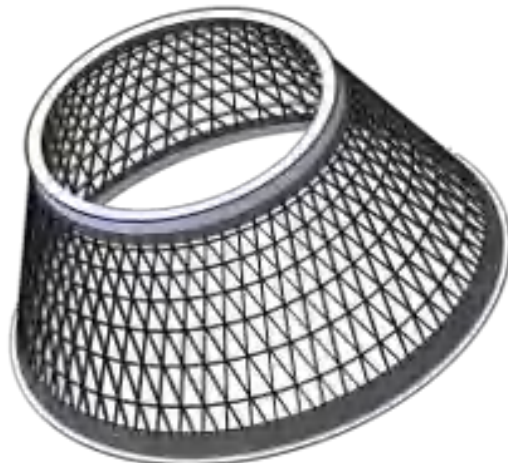
ATG Europe lattice cylinder test, 2019



Central cylinder design, 2019



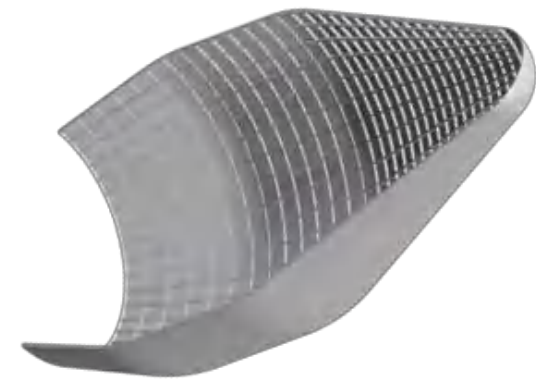
Satellite dispenser design, 2020



Payload adapter design, 2020



Launcher interstage design, 2020

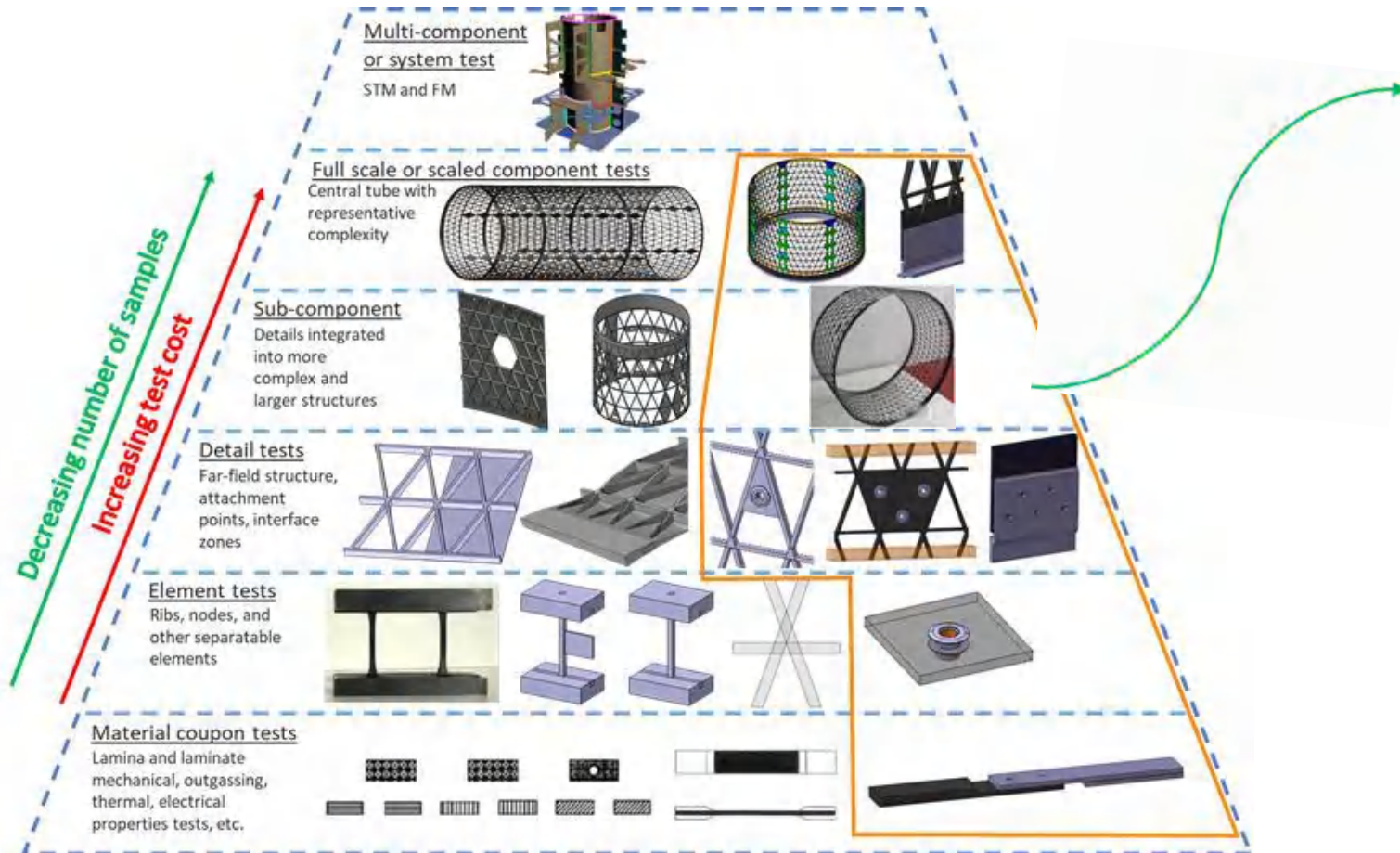


Payload fairing design, 2017

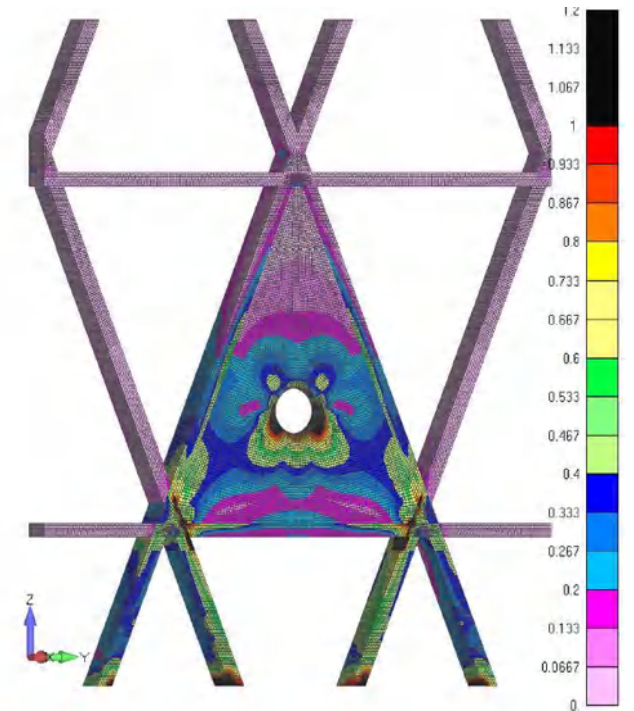
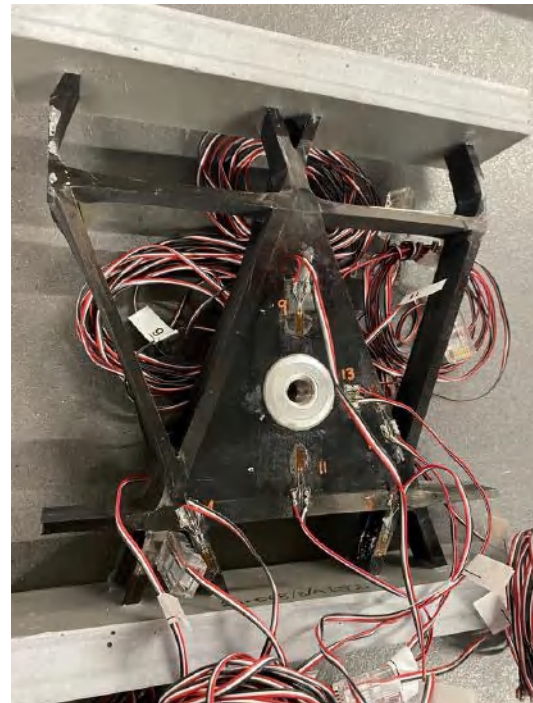
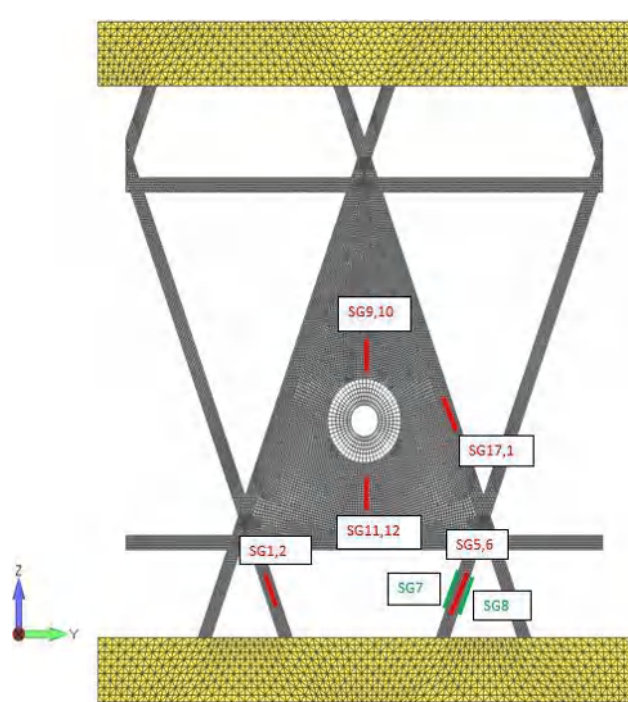
SUITABLE APPLICATIONS

	COMPONENT/APPLICATION	LATTICE/GS STRUCTURES BENEFITS*
LAUNCHERS	Interstage structures	49% mass reduction at marginal increase in cost
	Upper stages structure	44% mass reduction at similar cost levels
	Fairings	20% mass reduction with cost reduction upon automation
	Launch vehicle adapters	60% mass reduction w.r.t. aluminium, comparable costs
	Dispensers	38% mass reduction at comparable cost
SPACECRAFT	Central cylinders	35% mass reduction at 30% cost reduction
	Antennae support brackets	90% mass reduction , but at increased cost.
	Optical base plates of instruments	Ultra-high stiffness, CTE practically 0
AERO & INDUSTRIAL	Fuselages	27% mass reduction at 12% manufacturing cost increase
	High-accuracy/high-speed processing	Likely a stiffness increase of 20-30% possible, offering unique advantages
	Heavy machinery	Likely a stiffness increase of 50-60% possible, increasing payload capacity
	Wind turbine structures	67% mass reduction on masts with lower fatigue loads on blades

ONGOING WORK

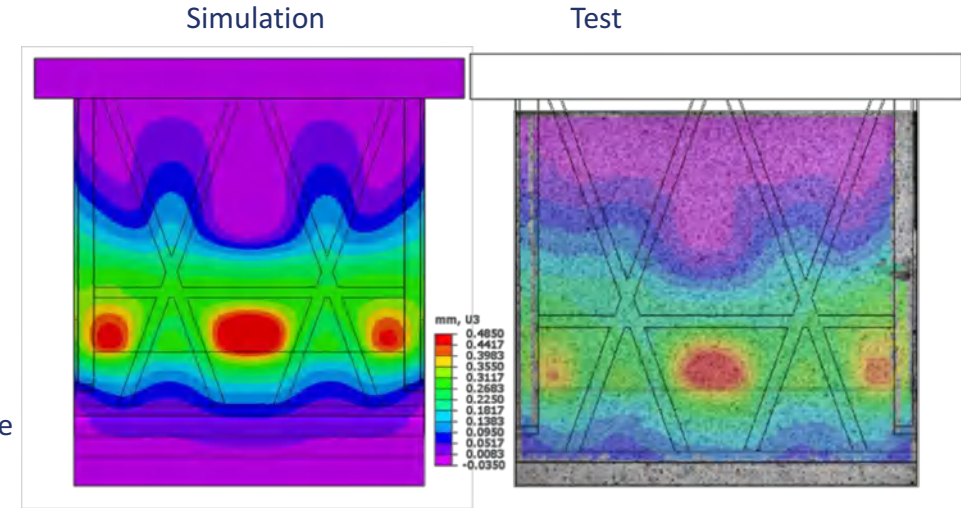
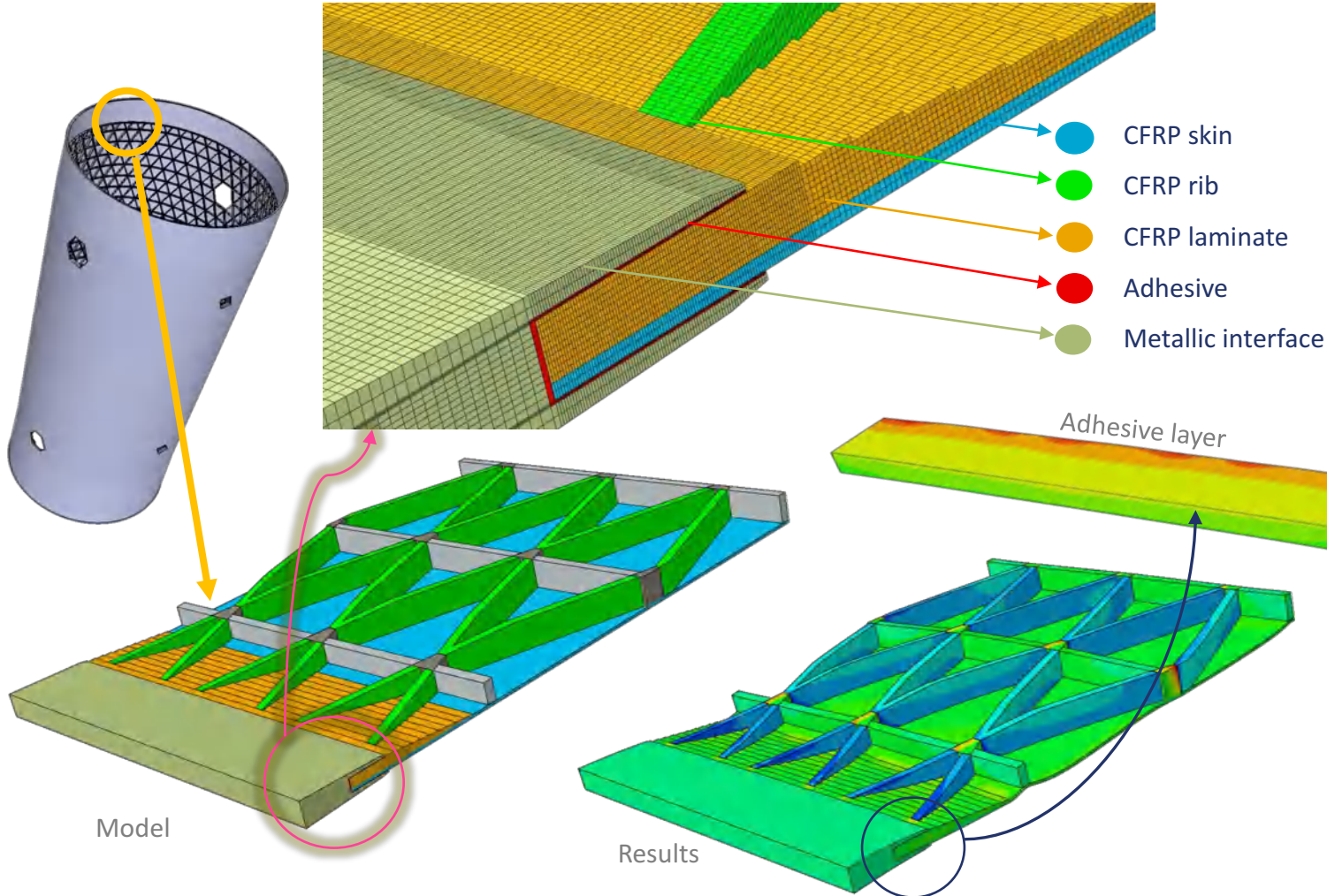


ONGOING WORK



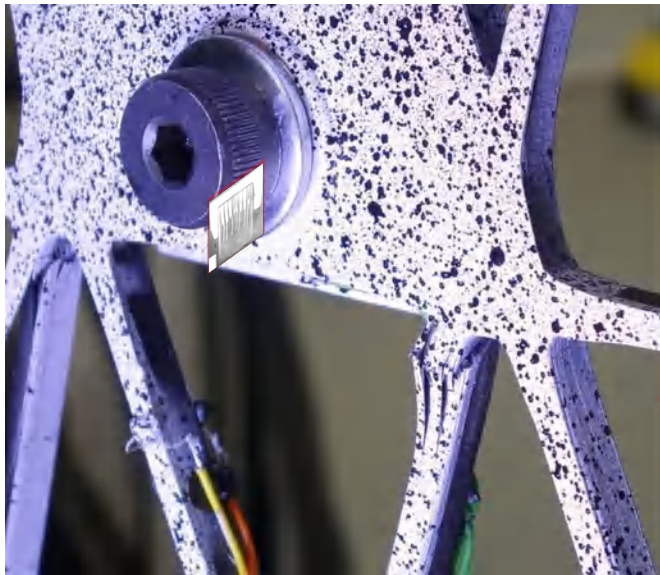
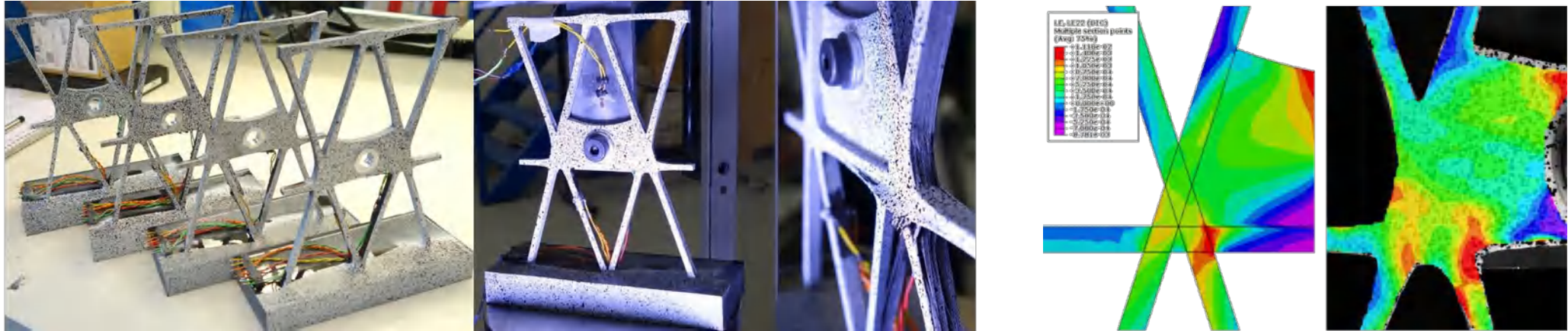
LAMINATE END ZONES

Automated very high fidelity solid element FE model



- Automated fully parametric modelling suitable for sensitivity and detailed design studies:
 - Grid angle and cross-section
 - Laminate drop-down and layup
 - Adhesive thickness/length

ATTACHMENT POINTS



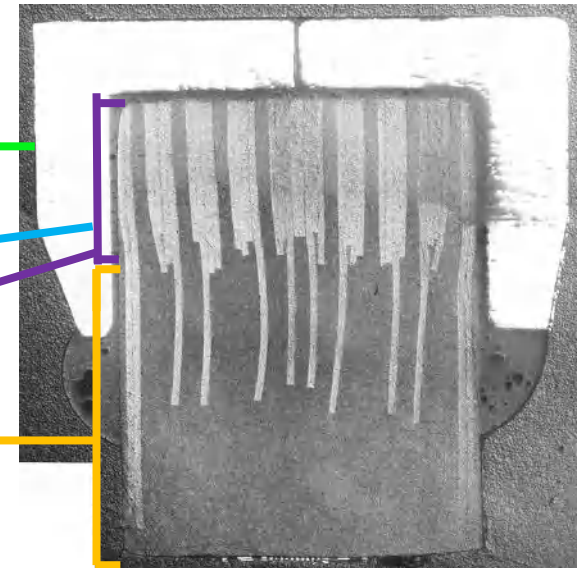
Insert

Adhesive

Patch

Rib

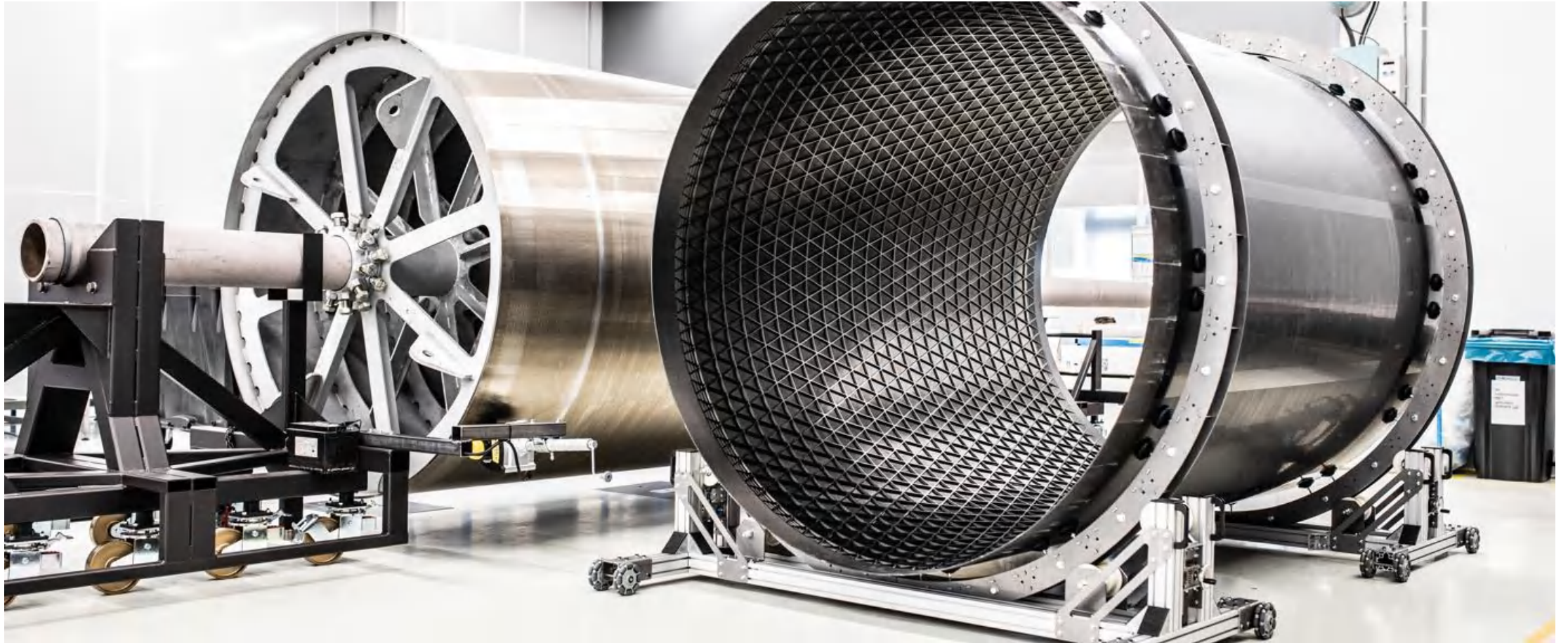
No damage!



LATEST DEVELOPMENTS IN PICTURES



LATEST DEVELOPMENTS (IN PICTURES)



ATG VIRTUALLAB

VIRTUAL & AUGMENTED REALITY ENGINEERING

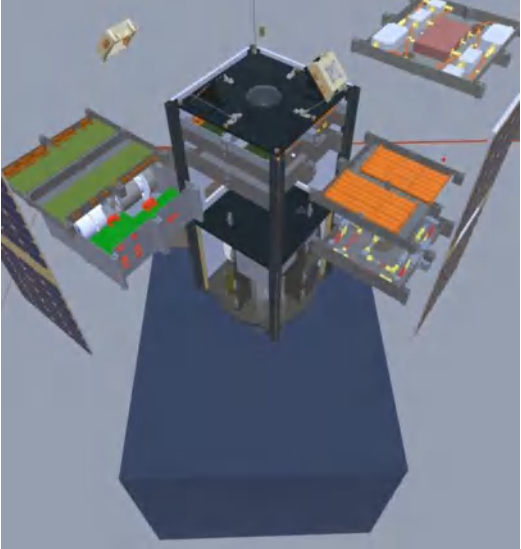
ATG's VR/AR business unit is developing engineering tools based on VR and AR technologies, including collaborative design tools, design review and reporting tools, training tools and communication applications.



VIRTUALLAB

Virtual & Augmented Reality Engineering

The VR/AR business unit is developing engineering tools based on VR and AR technologies, including collaborative design tools, design review and reporting tools, training tools and communication applications.



ATG MEDIALAB

MEDIALAB PRODUCES HIGHLY REALISTIC VISUALIZATIONS AND ANIMATIONS OF COMPLEX SYSTEMS.

By creating true to life computer generated images and videos, ATG MediaLab offers its audience the possibility to see and experience the unseen.



ATG MEDIALAB



- More than 20 years' experience in scientific and technological visualisation.
- A dedicated team of highly skilled 3D specialists with broad expertise
- Thorough understanding of technical requirements of complex objects
- Use of high-end 3D rendering software and high-performance server cluster
- Long-term work/trust relationships with ESA/ESTEC, ASML and all space LSI