Software Enabled Space:

How Simulation Accelerates Space for Good

Classification: Public Event Audience

Prepared by ICON

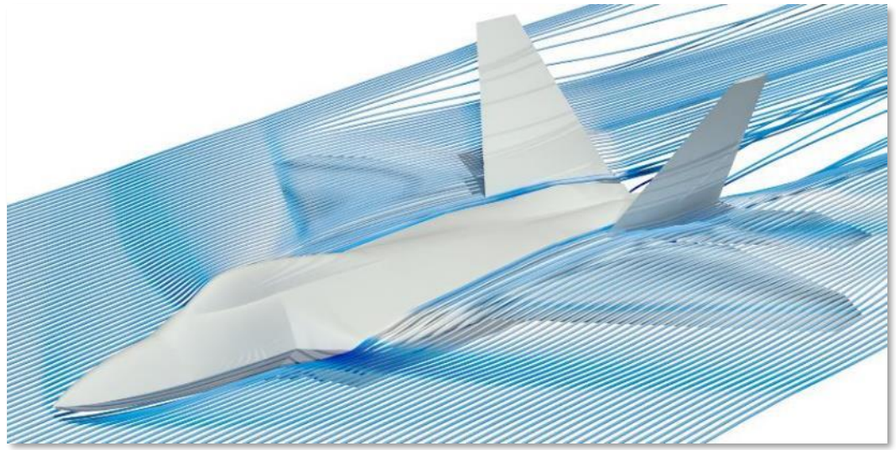
Agenda

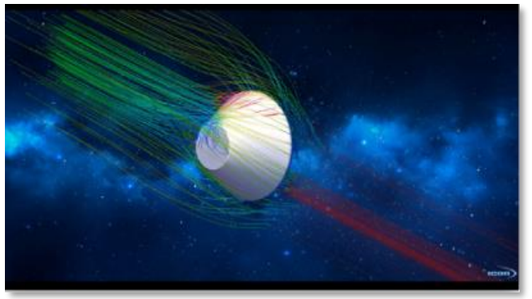
01	02	03	04	05	06
Welcome & Introduction	Space Industry Applications	Space for Good - Dual Use	Software Enabled Space	Future Outlook / Trends	Q&A & Close

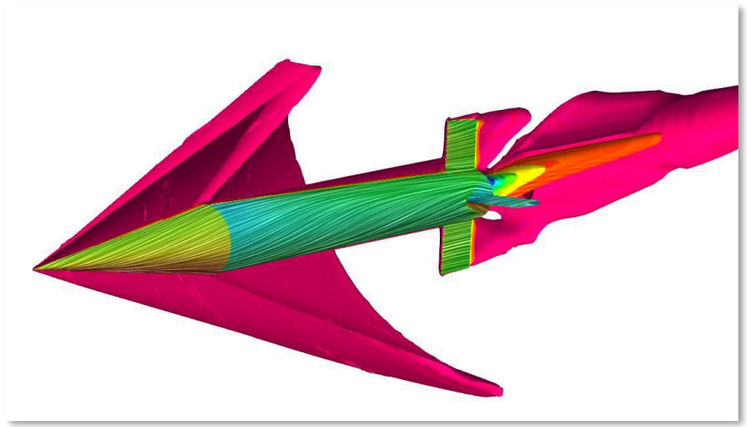
Welcome & Introduction

Introduction - Software Enabled Space

- Thank-you to WCIT
- Why Space Matters
- Exploring software simulation role in space applications
- Focus on technical insights and some real-world example applications



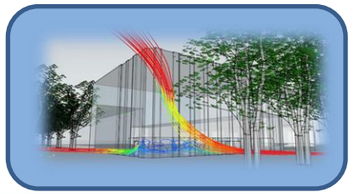




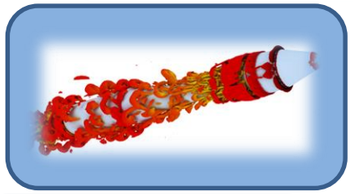
Introduction

- 30+ years of engineering excellence
- Trusted global CFD software provider converging simulation, cloud & AI technologies
- Industry-driven Software:
  - iconCFD®
    - Robust, supported simulation software without limits
  - iconPlatform
    - Data-driven CAE simulation and collaboration cloud

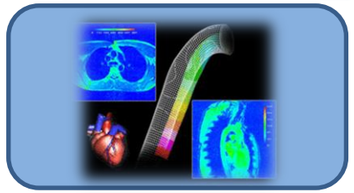
Industry Applications



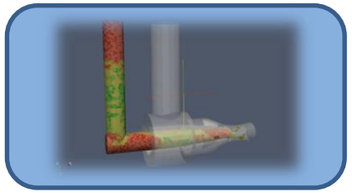
- Buildings & Environment



- Aerospace Space



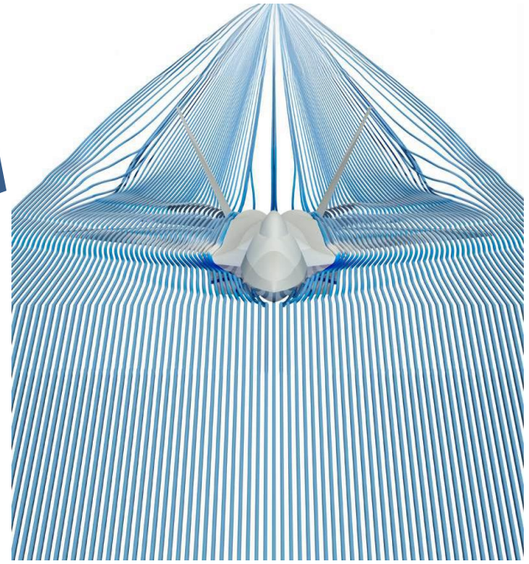
- Health



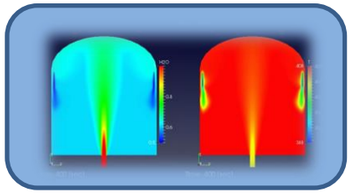
- Chemical

- Automotive

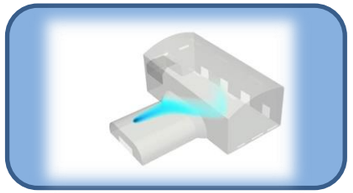
- Manufacturing



- Energy



- Defence & Security



- Food Processing

Industry Recognition

"The technical and business benefits delivered by the process from ICON are significant."

VW Group

"Thanks to the ICON team for your efforts within the AIRBUS A380 project since the very beginning. Congratulations for the results of the work you have done."

Airbus

"The latest evolution of our Praga R1 boasts significantly improved aerodynamics ... The shape of the virtual prototype was carefully refined in ICON Digital Wind Tunnel for higher downforce, lower drag, better stability and agility."

Praga

"We are delighted to be using iconCFD in our simulation activities. The licence-free solver technology, combined with Icon's support from their applications and development team, are ensuring a powerful, cost-effective use of resources at Dstl."

Dstl

(Defence Science and Technology Laboratory)

"Thank you to everybody at ICON - I am certain the CFD program contributed to the Ford on track performance and success, thank you."

Ford Performance

"...The Launcher Digital Wind Tunnel App on iconPlatform has become a cornerstone of our aerodynamic development at MaiaSpace..."

MaiaSpace

"Thanks to ICON we have achieved outstanding results in very tight time frame. The key role of ICON in this achievement is undoubted. The ICON on-site staff has demonstrated high level of professionalism and education."

Skoda Auto

"The open source licensed solver technology, combined with support from ICON's application and development team, are ensuring a powerful, cost-effective use of resources at Koenigsegg."

Koenigsegg

"EU Commissioner commends ICON next generation digital WT at Europe's largest trade show."

EU Commission

"ICON's solution is the best way how to bring uncompromised flow simulations to the offices of a private, small-scale motorsport manufacturer."

CTR Developments

"iconCFD is the most used software on our High-Performance Computers (HPC) globally"

"ICON technology stands out even when compared to the current market leader."

"We have saved over $10m in software costs alone"

"This tool has truly elevated our confidence in performance predictions as we build Europe's future launchers."

maiaspace

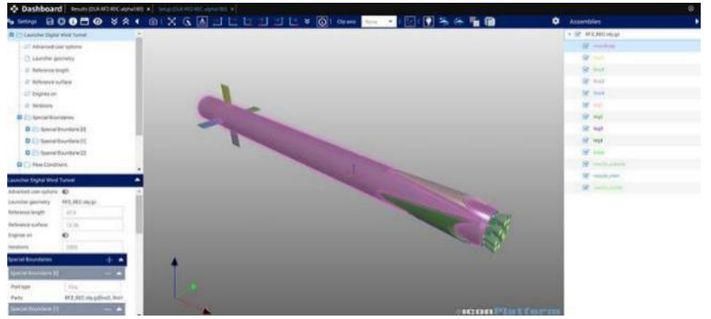
"I am really worried about the dominance of Siemens, we don't want to be tied-in"

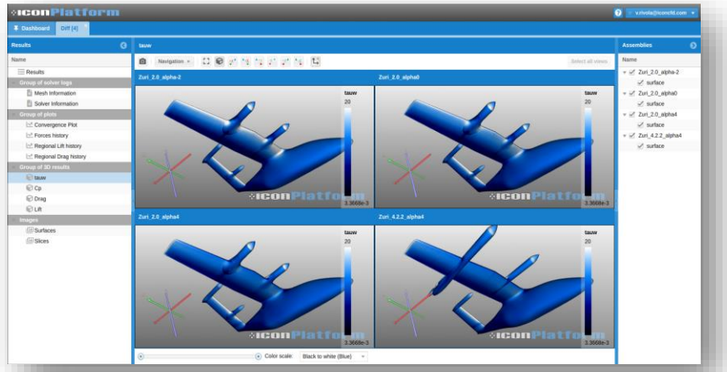
"One less physical prototype vehicle would save €1m. That alone covers the cost of the ICON software" "

Space for Good

- **Advancing Sustainable Space Exploration**
  - Optimizing launch efficiency to reduce emissions
- **Enhancing Safety for Astronauts and Equipment**
- **Fostering Global Collaboration**
  - Sustainable and impactful missions
  - Supporting climate monitoring satellite missions
  - Humanitarian applications: disaster response, planning
- **Accelerating AI-Driven Scientific Discovery**
- **Democratizing Access to Space Education**
- **Diversity of thought, background, and expertise**

Space for Good - Education





Digital engineering for space can have a meaningful impact on education, inspiring students and in advancing technical learning.

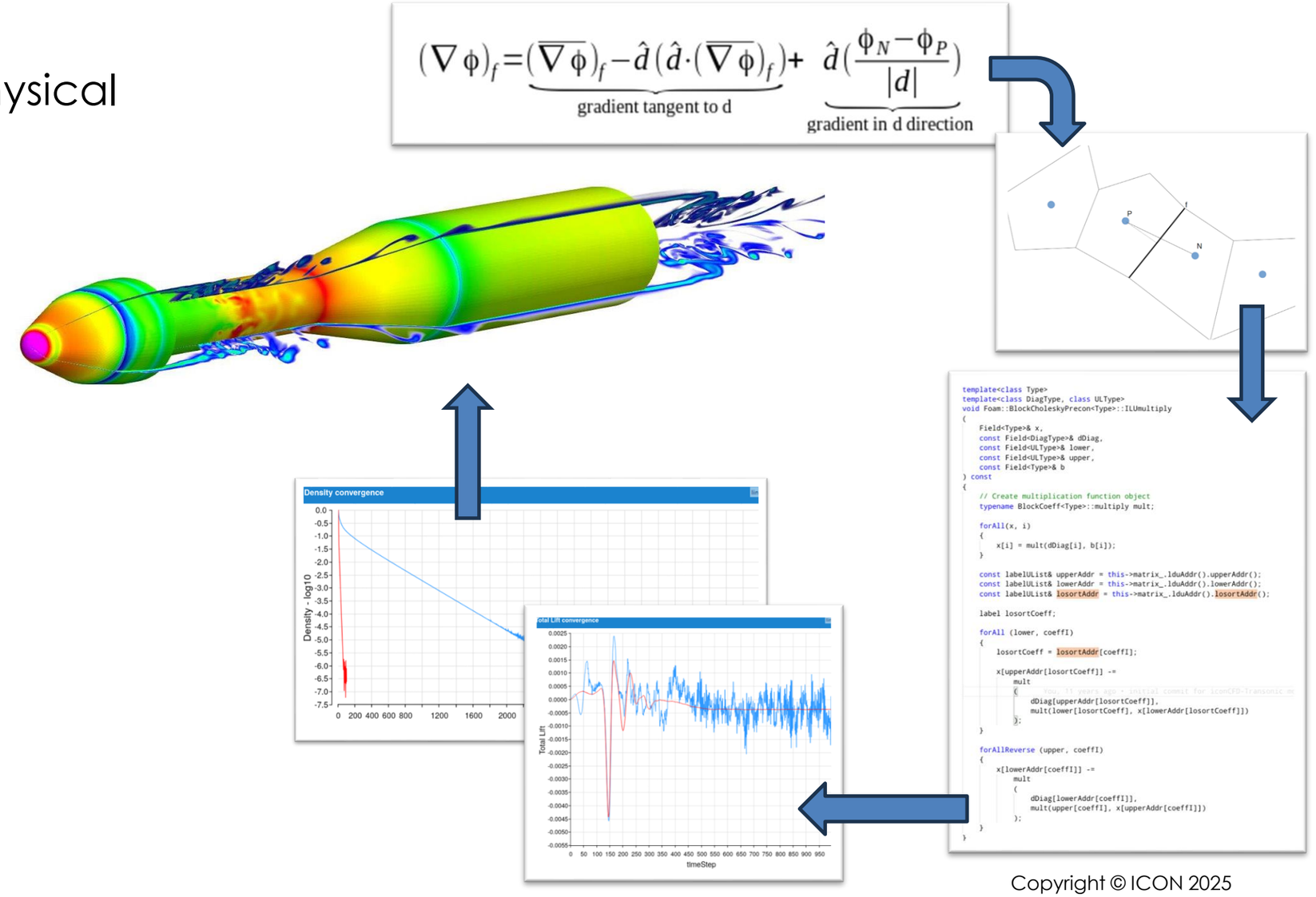
- Real-World Applications Enhance Engagement
- Promotes Interdisciplinary Learning
- Encourages Diversity and Inclusion
- Supports Advanced Research and Innovation
- Enables Hands-On Learning
- Collaborative Learning Platforms – Global Research Networks
- AI-Enhanced CFD Tools
- AI for Personalized Learning

Dual Use: Civil & Defence

- Aerodynamic Design of Aircraft
- Stealth Technology
- Environmental Control Systems
- Thermal Management
- Propulsion Systems
- Weapon Systems and Projectiles

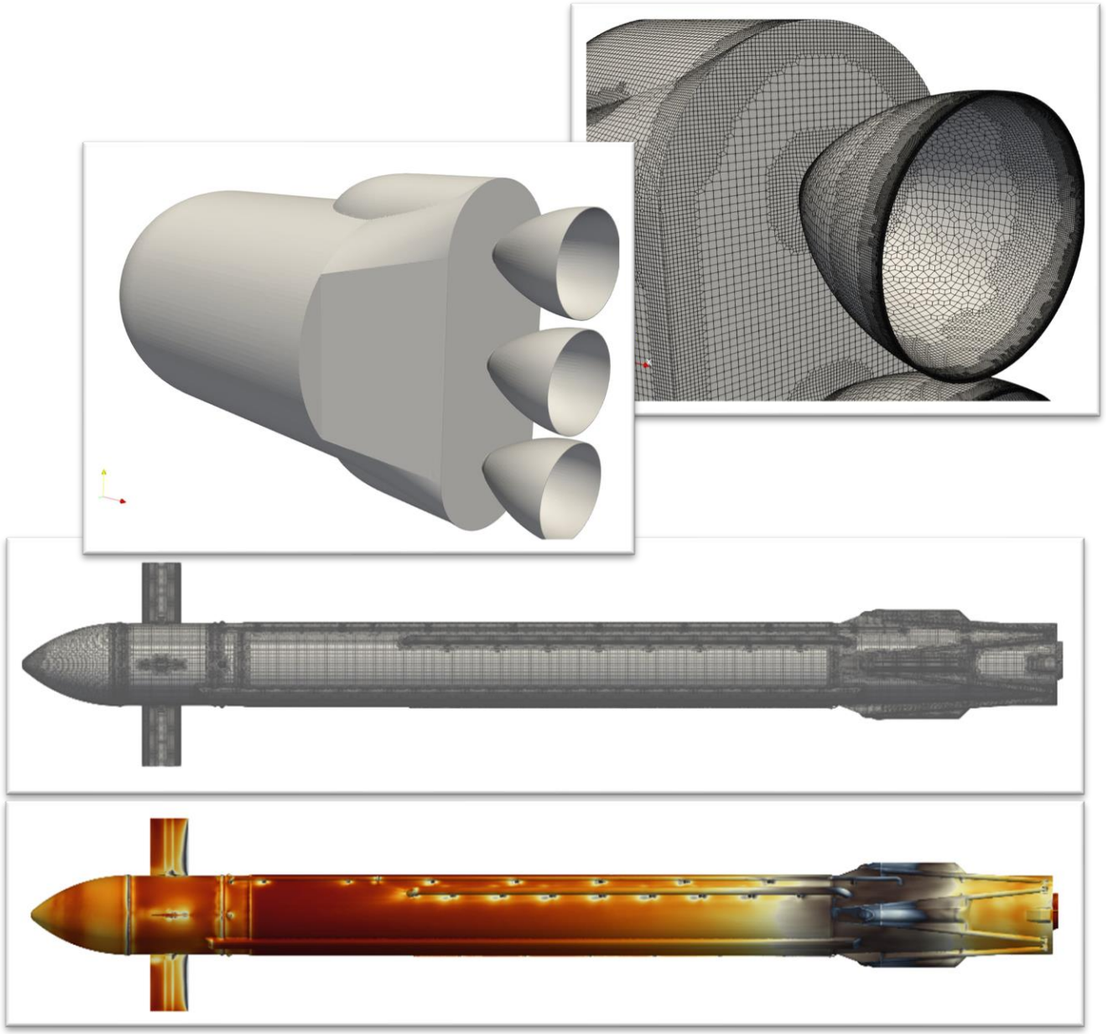
Software Enabled Space – Computational Scientist Role

- Numerical Methods and Physical Models development
- Software development
- Problem Solving
- Testing
- Validation
- Support



Software Enabled Space

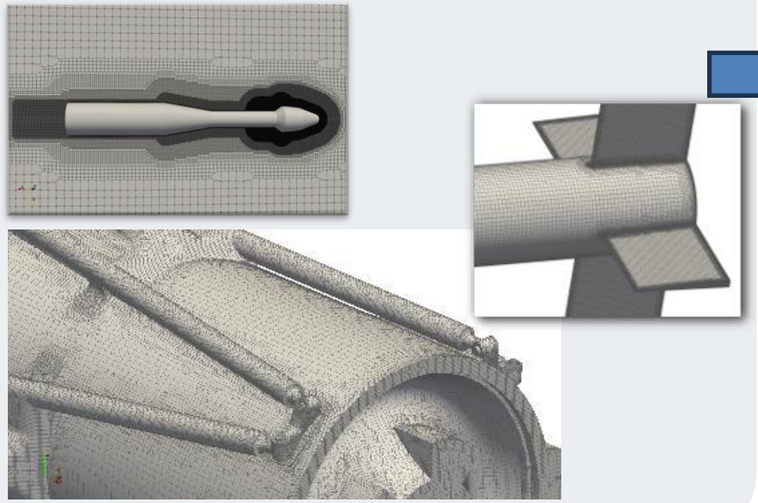
- Digital representation
  - Virtual model
  - Constraints and physical conditions
- Simulation
  - Computational Fluid Dynamics (CFD)
- Visualisation
  - View and manipulate the results
  - Gather and compare relevant data
- Analysis
  - Gain understanding



Software Enabled Space – Workflow

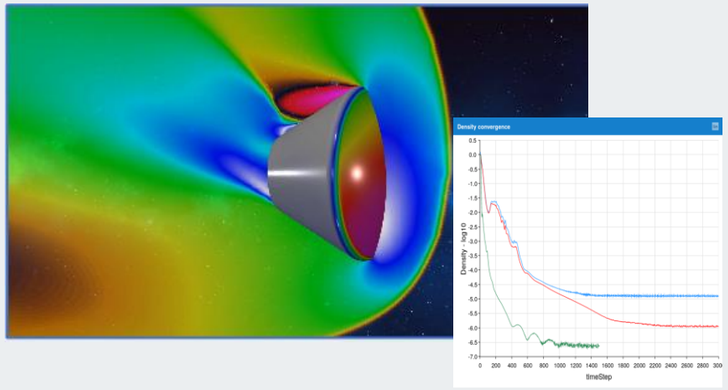
Model Preparation

- CAD generation and clean up
- State-of-the-art, automated mesh generation
- Preprocessing and physical conditions set up



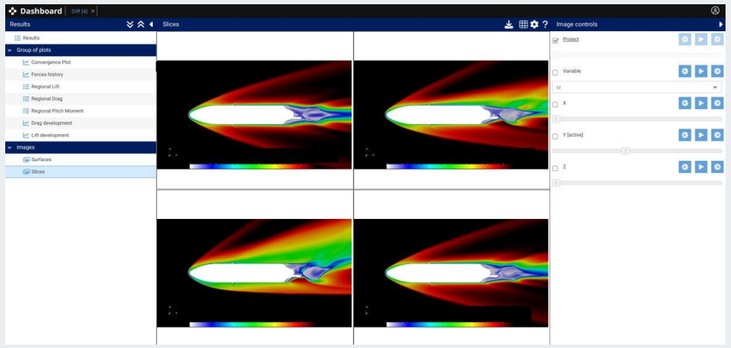
Simulation

- High-fidelity CFD simulation
- Multi-physics numerical models
- Compressible turbulence models
- HPC



Post Processing & Analysis

- Real world data integration
- Validation
- Correlation



Software Enabled Space – Why do we use it?

Concept Design

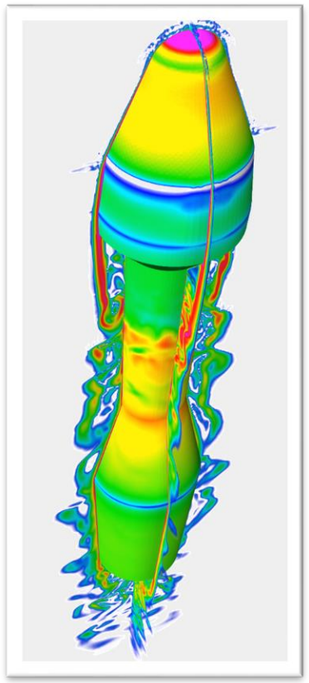
Scenario Modelling

Operational Extremes

Risk Management

Deep Analysis

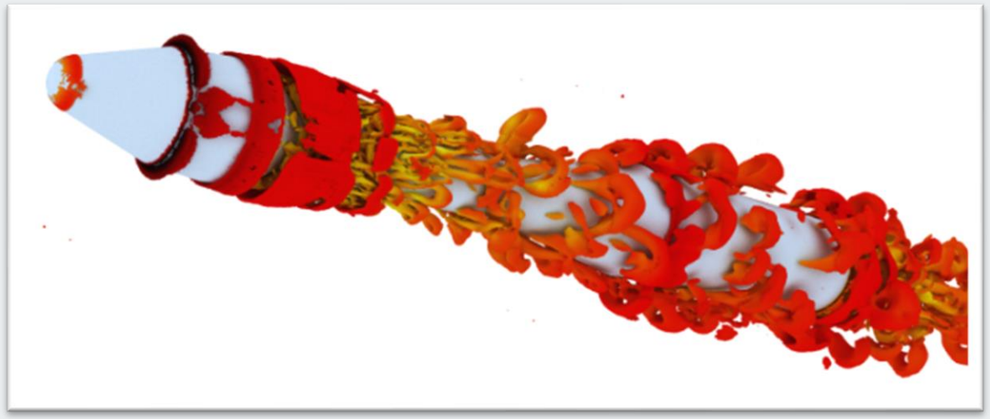
Optimisation



Software Enabled Space – Case studies

Launcher simulations

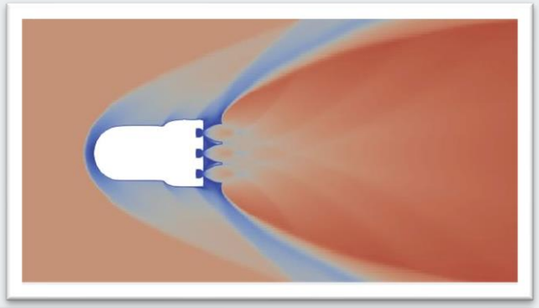
- Reusable & expendable
- Low speed/altitude ➞ high speed/altitude
- External Aerodynamics
- Compressibility effects
- Aerothermodynamics

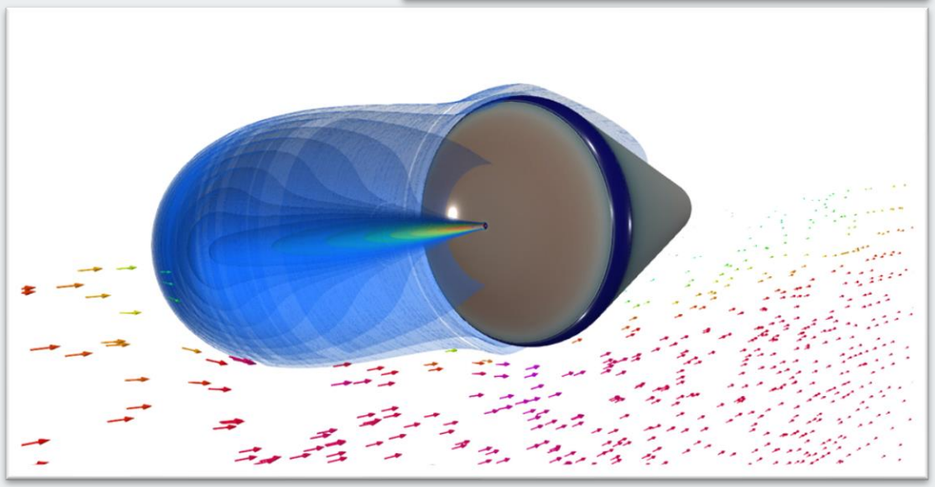


Software Enabled Space – Case studies

Engine Plume Simulations

- 4 phases: Take off, Ascent, Descent, Landing
- Engine On/Off
- Landing pad design – jet impingement
- External Aerodynamics
- Multi-species flows
- Aerothermodynamics
- Aeroacoustics

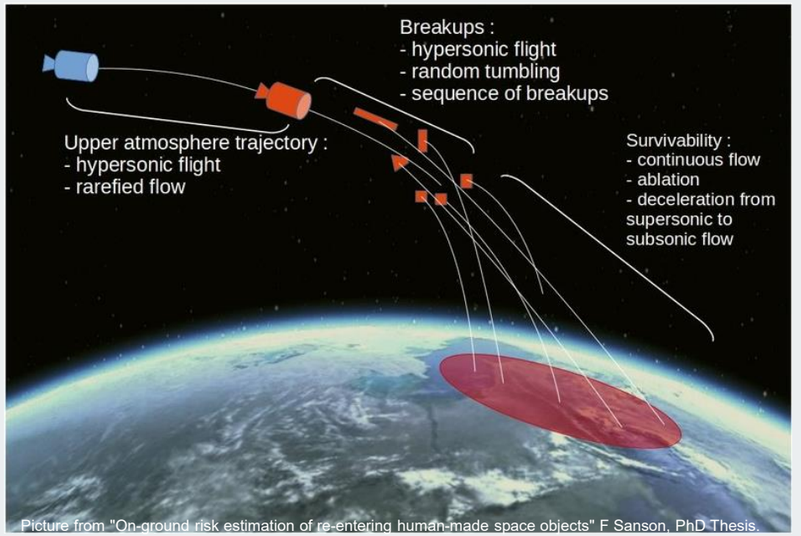




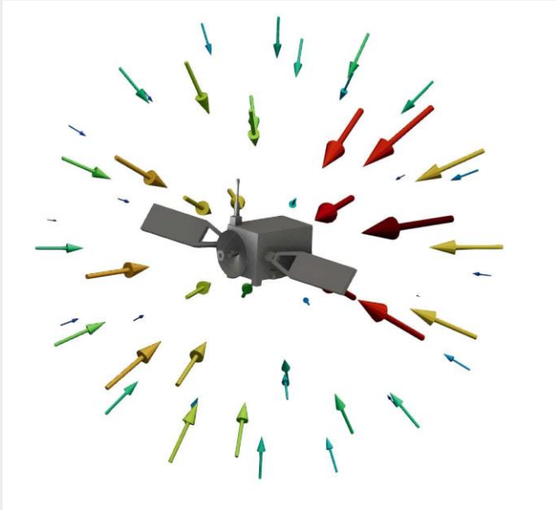
Software Enabled Space – Case studies

Space Debris Simulations

- Multiple small fragments
- End of life Laws (EU)
- Failure Scenarios (safety)
- Satellite re-entry burn up
- Trajectory prediction
- External Aerodynamics
- Aerothermodynamics



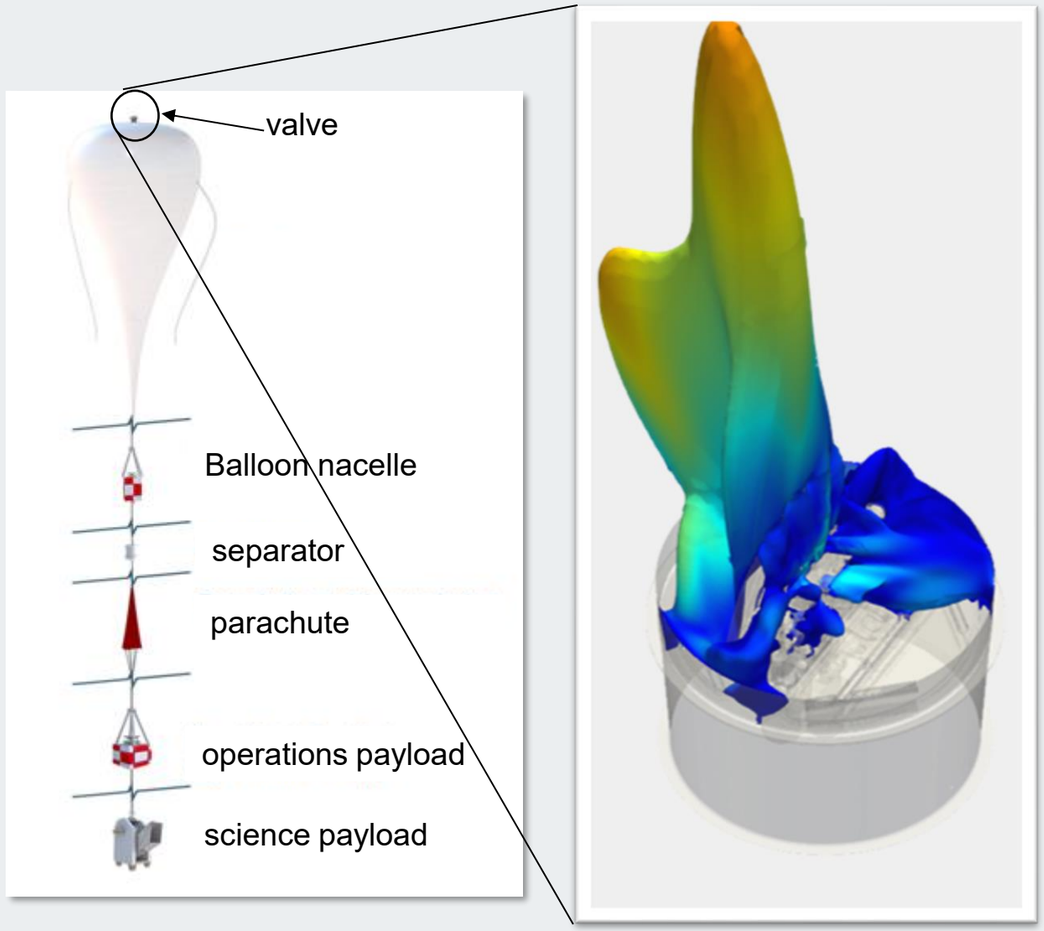
Picture from "On-ground risk estimation of re-entering human-made space objects" F Sanson, PhD Thesis.



Software Enabled Space – Case studies

Balloon Simulations

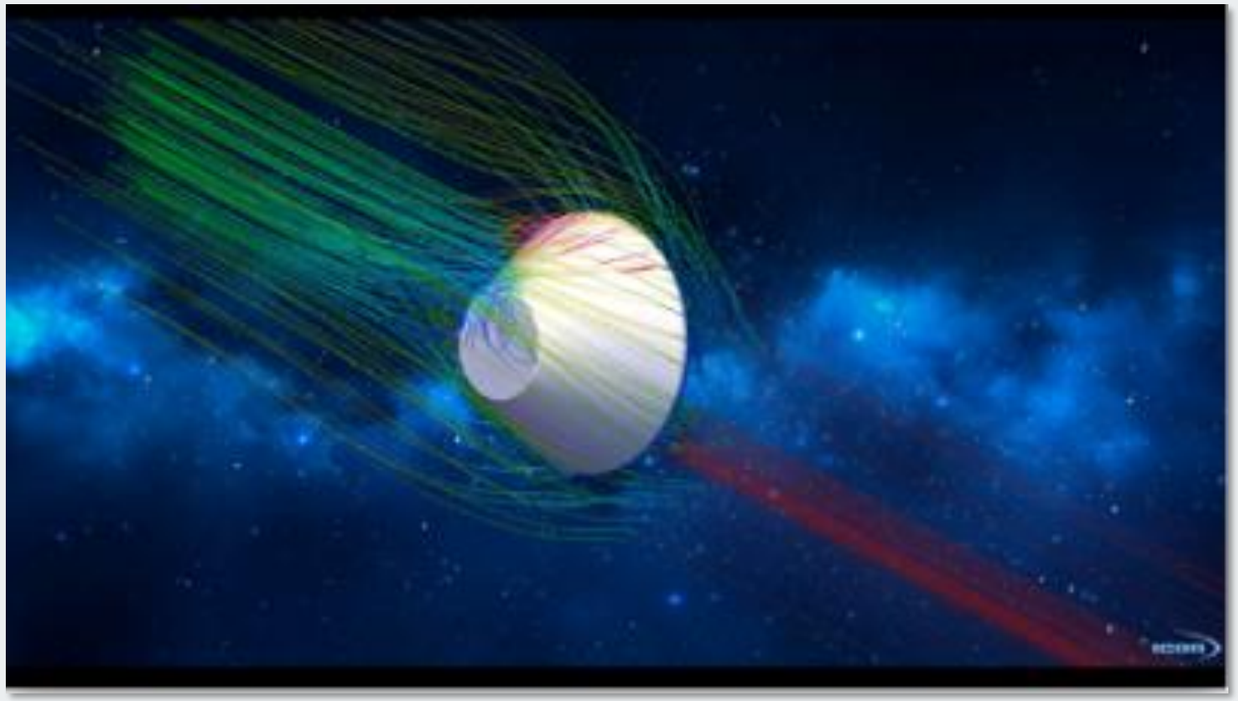
- Research
- Observation
- Trajectory predictions
- High altitude/low speed
- External Aerodynamics
- Aerothermodynamics
- Multi species simulations



Software Enabled Space – Case studies

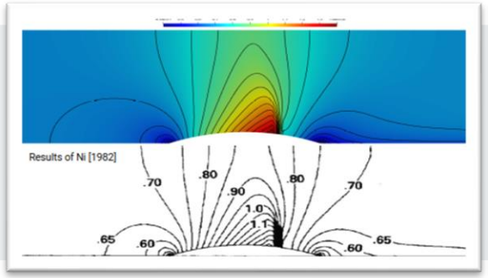
Space Capsule Re-entry

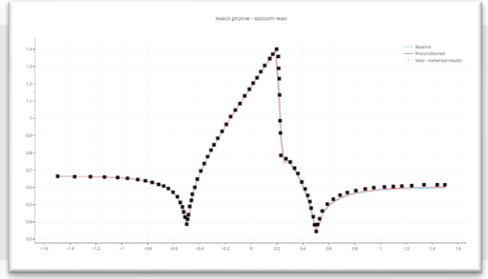
- High Speed - Hypersonic
- High altitude - low density
- External Aerodynamics
- Aerothermodynamics

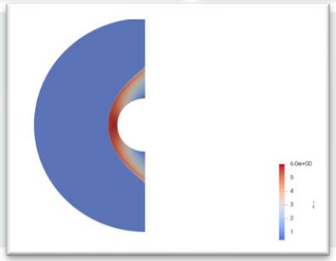


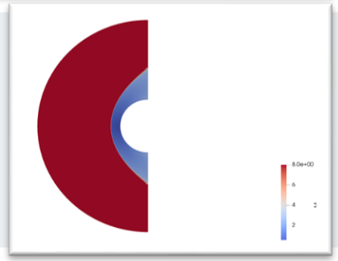
Software Enabled Space – Validation

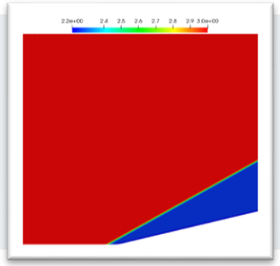
- Transonic Bump
- Hypersonic Cylinder
- Supersonic Wedge
- CNES Nozzle Plume

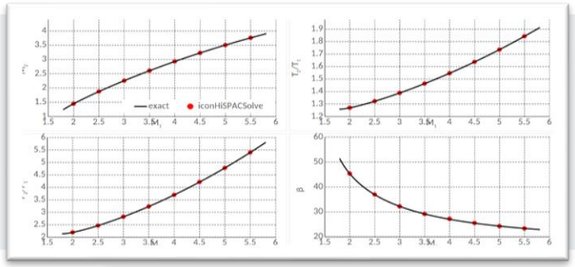


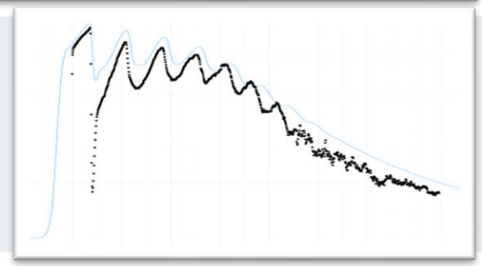


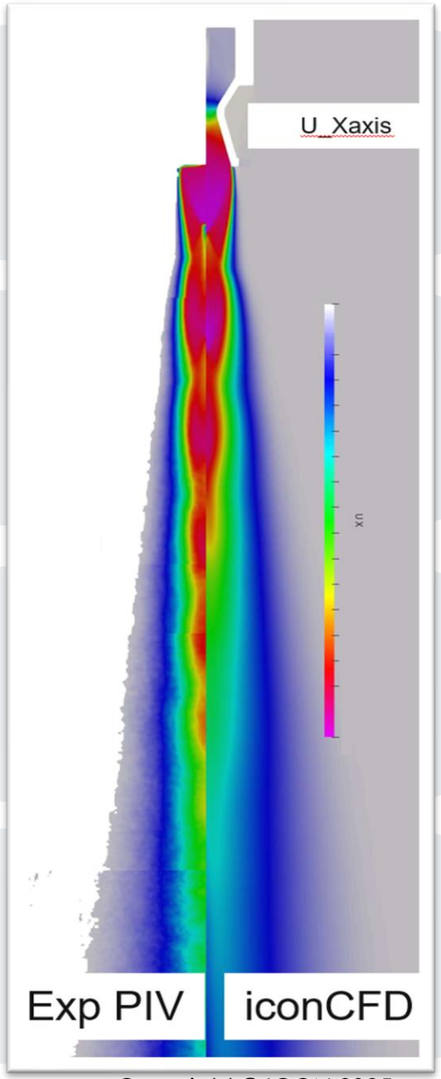






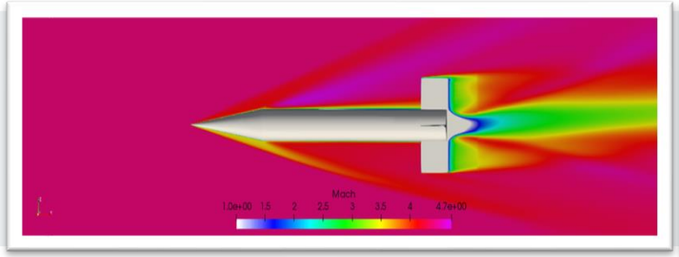


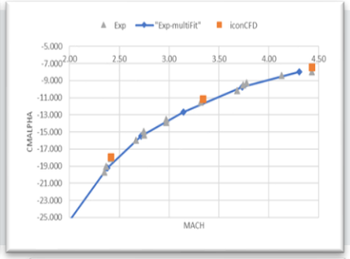




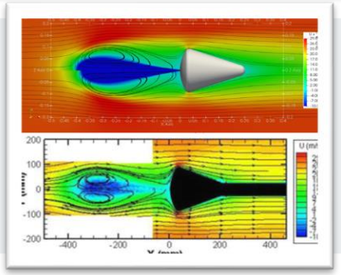
Software Enabled Space – Validation

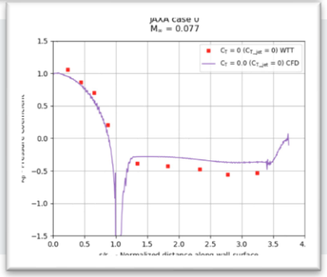
- Basic Finner Supersonic Projectile
- JAXA RVT Vertical Landing Vehicle
- NASA X778 Transonic Launch Vehicle
- DLR F6 Full Aircraft Configuration

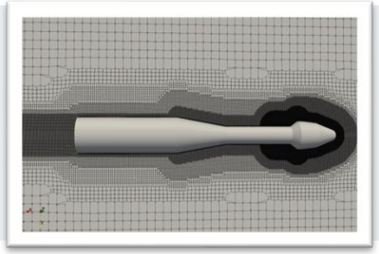


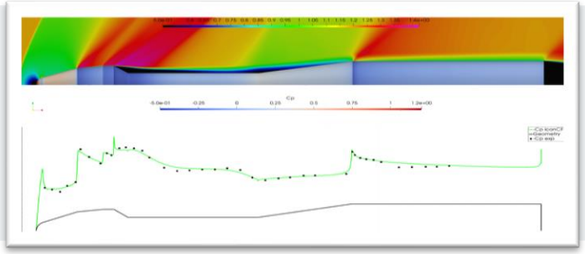


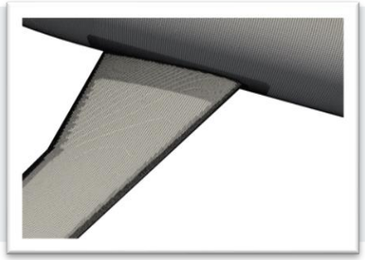
Picture from JAXA

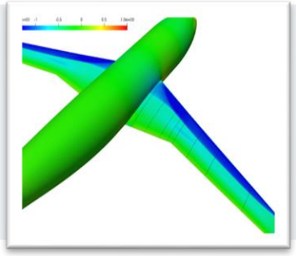


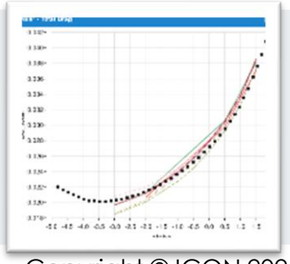






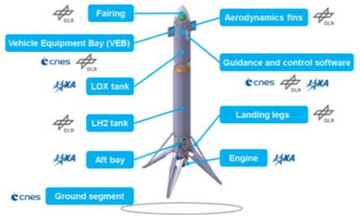


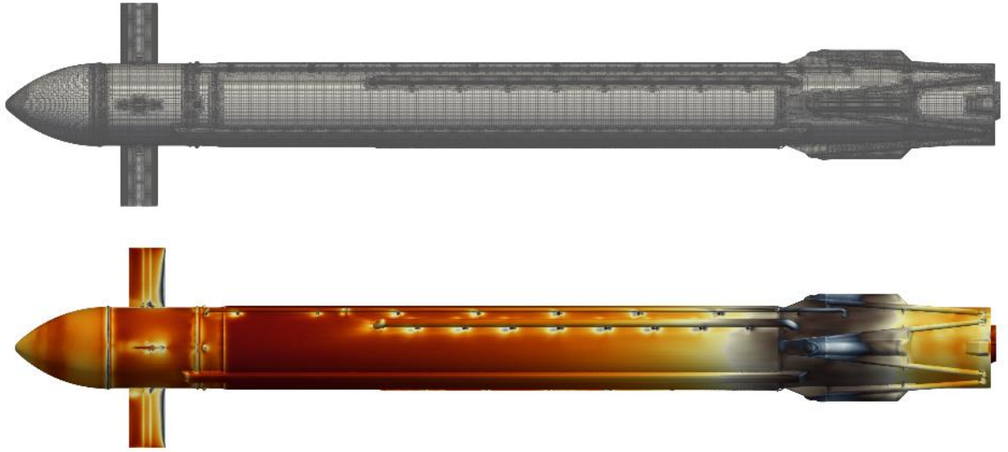




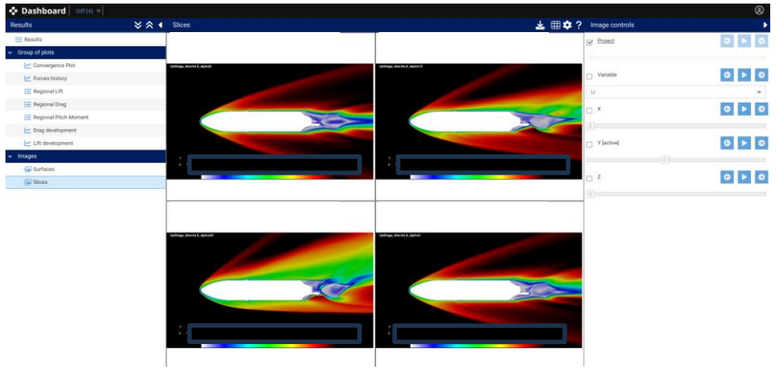
Software Enabled Space - Collaborations

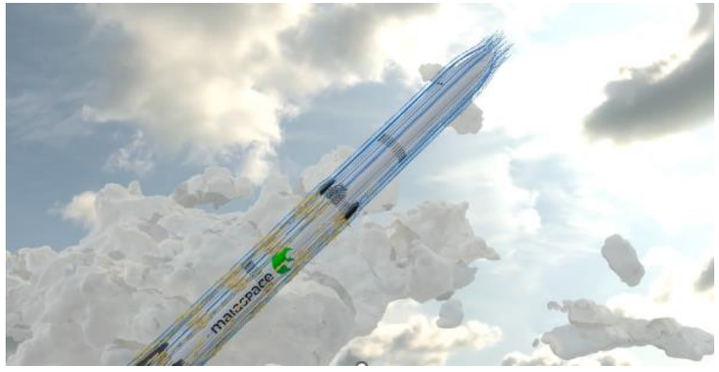
- CALLISTO project (CNES, JAXA, DLR)



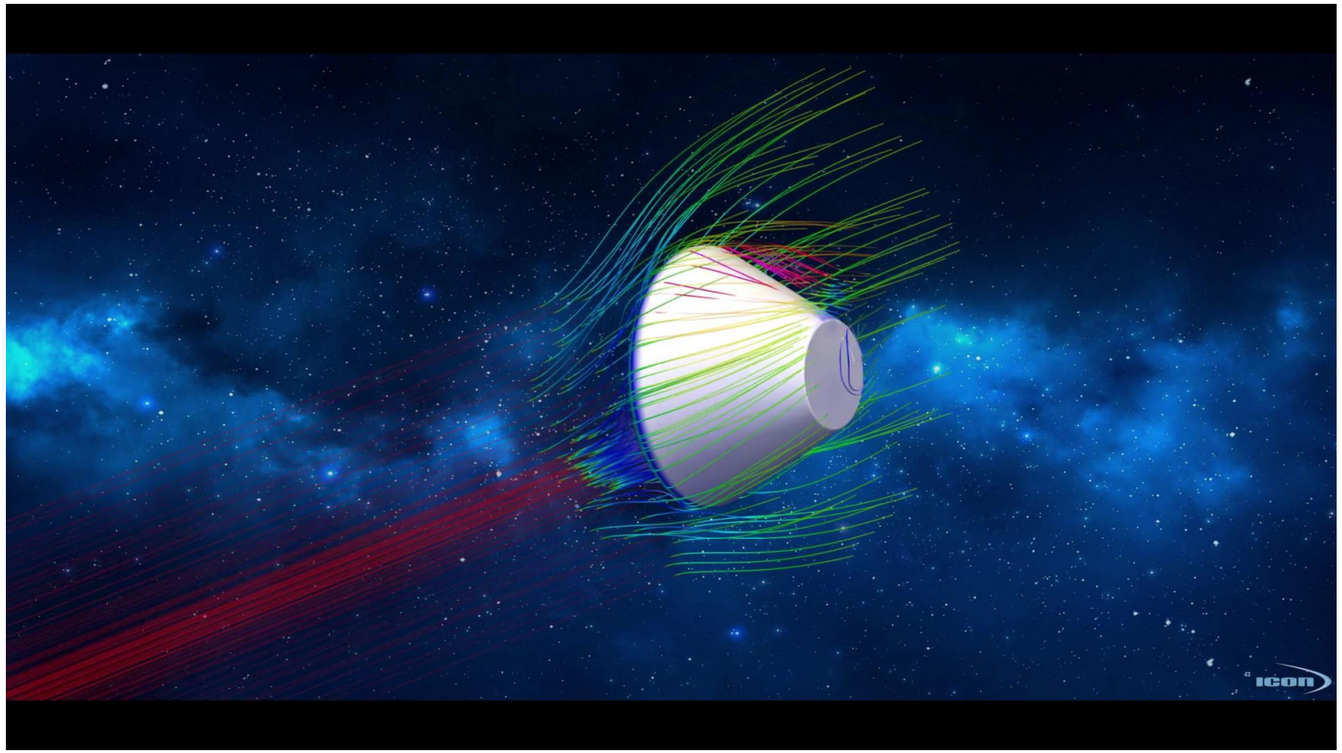


- MaiaSpace





Software Enabled Space – Example



Future Outlook & Trends?

Pressures

Physical product development and testing are under pressure due to rising energy prices, environmental and geopolitical concerns.

AI-driven real-time digital twins

Industry is seeking huge savings in time and energy right now by leveraging real-time AI-driven systems for digital product design.

Converging AI + Cloud + Simulation is key. Cloud and GPU adoption is collapsing the cost and widening the potential market and offer potential digital twins.

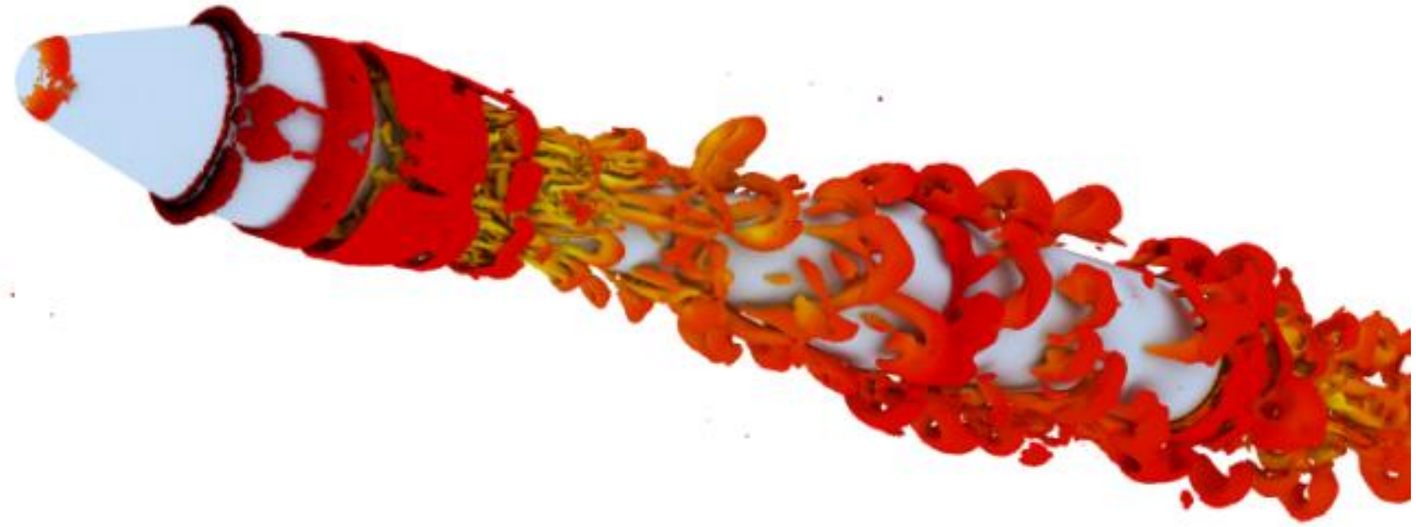
Speed of Action

The right people, tools, experience and vision will capture this multi-billion per year opportunity.

Space for Good will ensure we have impact here on the ground.

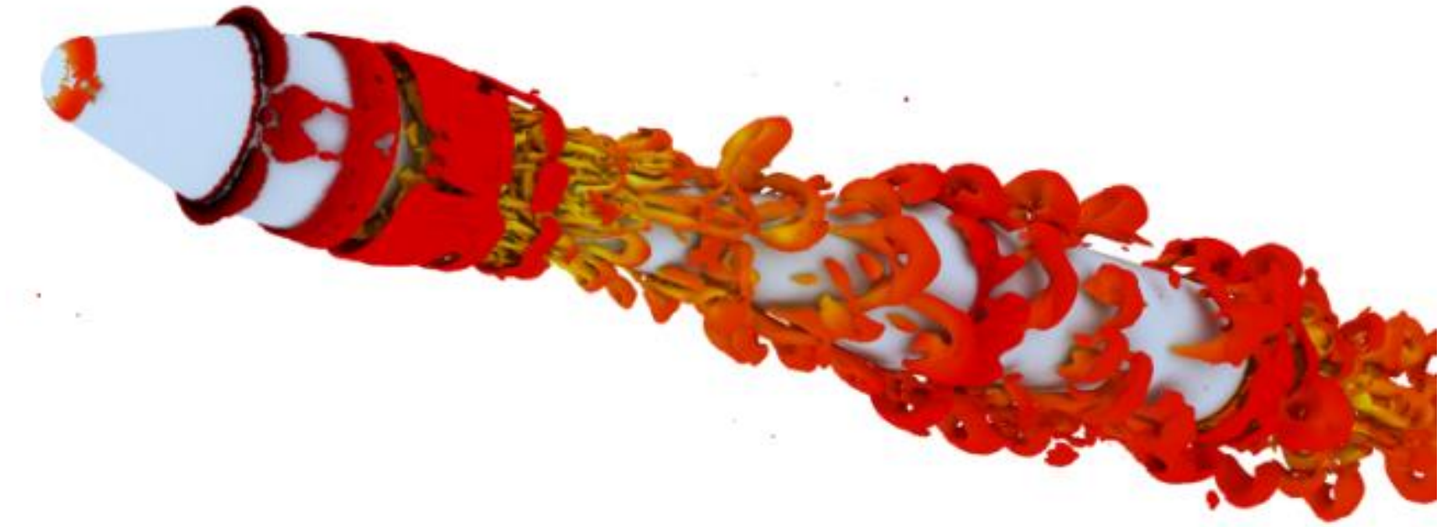
Q & A

- We open the floor for questions!



Close

- Explore our CFD simulation resources and connect with our experts
- Thank you for participating!

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