



OST

Ostschweizer
Fachhochschule

From basics to system engineering

Workbook for rocket recovery systems

Aerodynamics.ch

Prof. Hanspeter Keel
BSc Adrian Senn

28. August 2022

IPEK – Institut für Produktentwicklung & Konstruktion



Mission wo:men on Mars will beginn with a parachute



28. August 2022



We are space enthusiasts



Prof. Hanspeter Keel

- System Engineering
- Rapid Prototyping
- Space Engineering



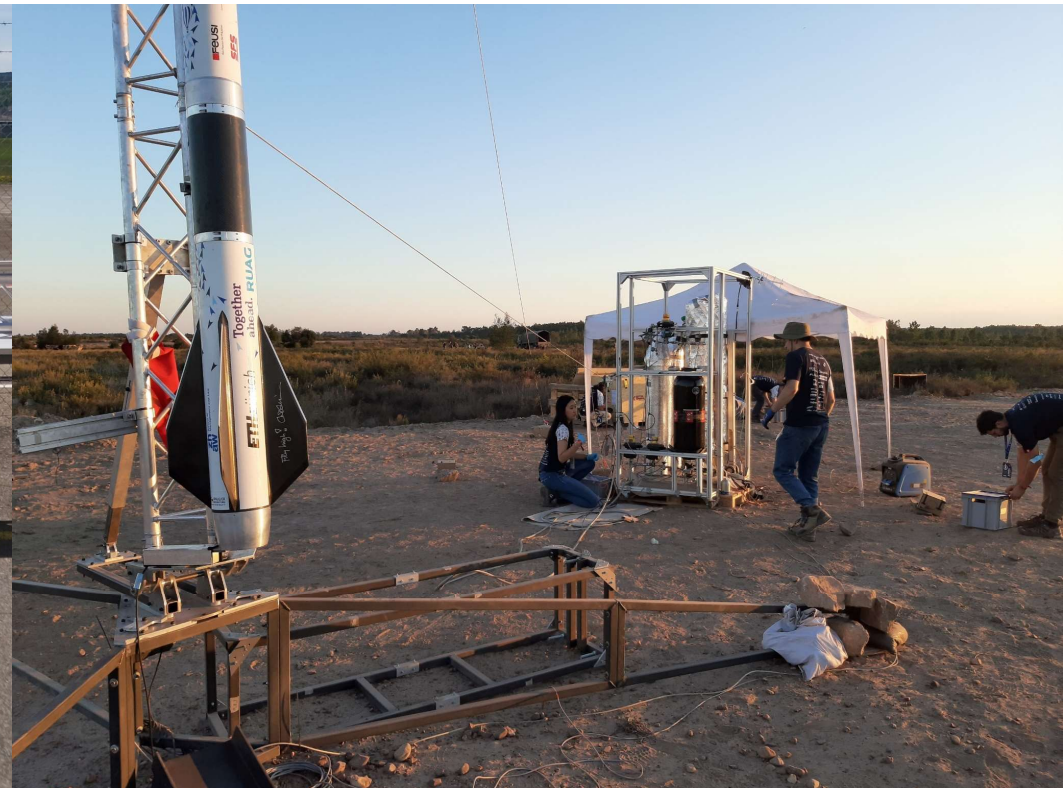
BSc Adrian Senn

- Bachelor of Science in mechanical engineering
- Researcher

aris
space to grow

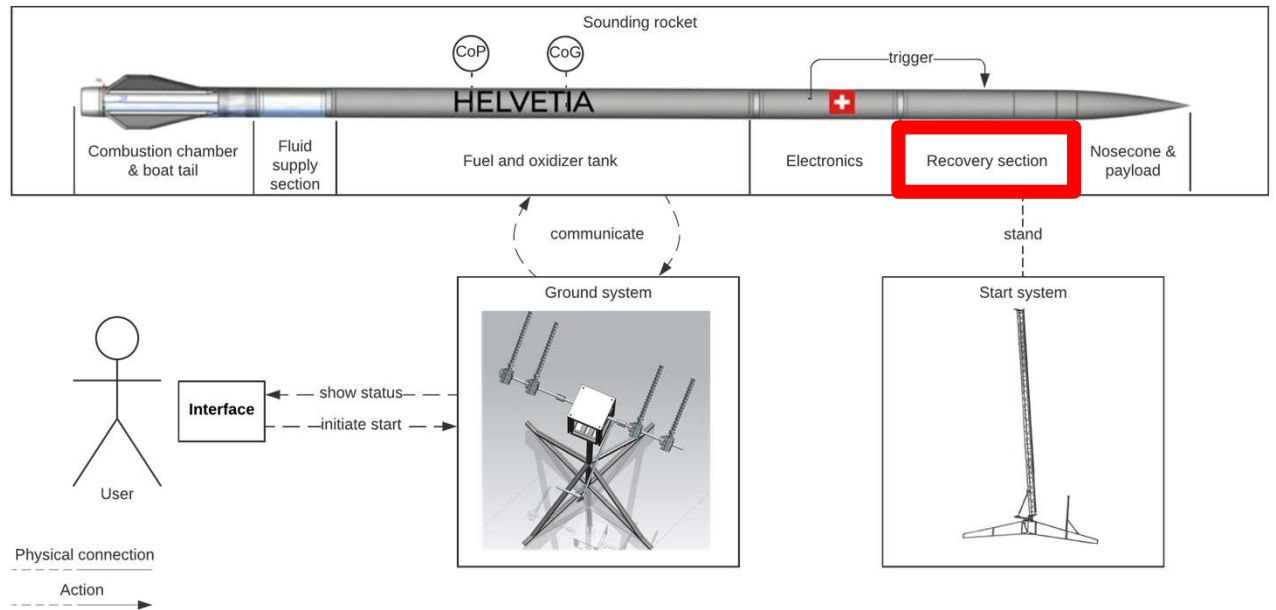
Akademische Raumfahrt Initiative Schweiz (ARIS)

One of the goals of ARIS



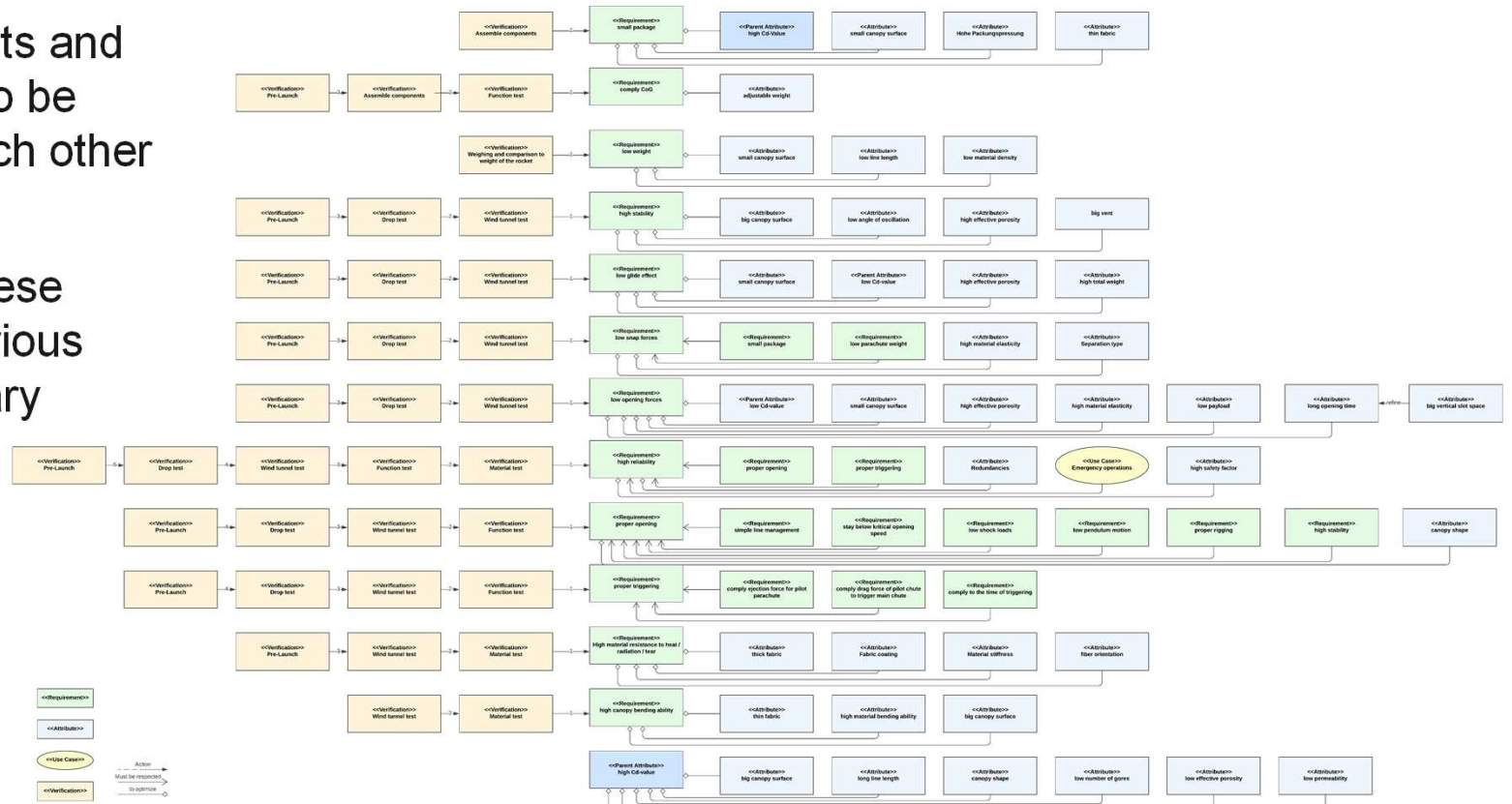
What we teach to students does not work anymore

- Recovery system has interfaces to many other systems
- Shock load need to be as low as possible in any situation
- Normally development with VDI 2221



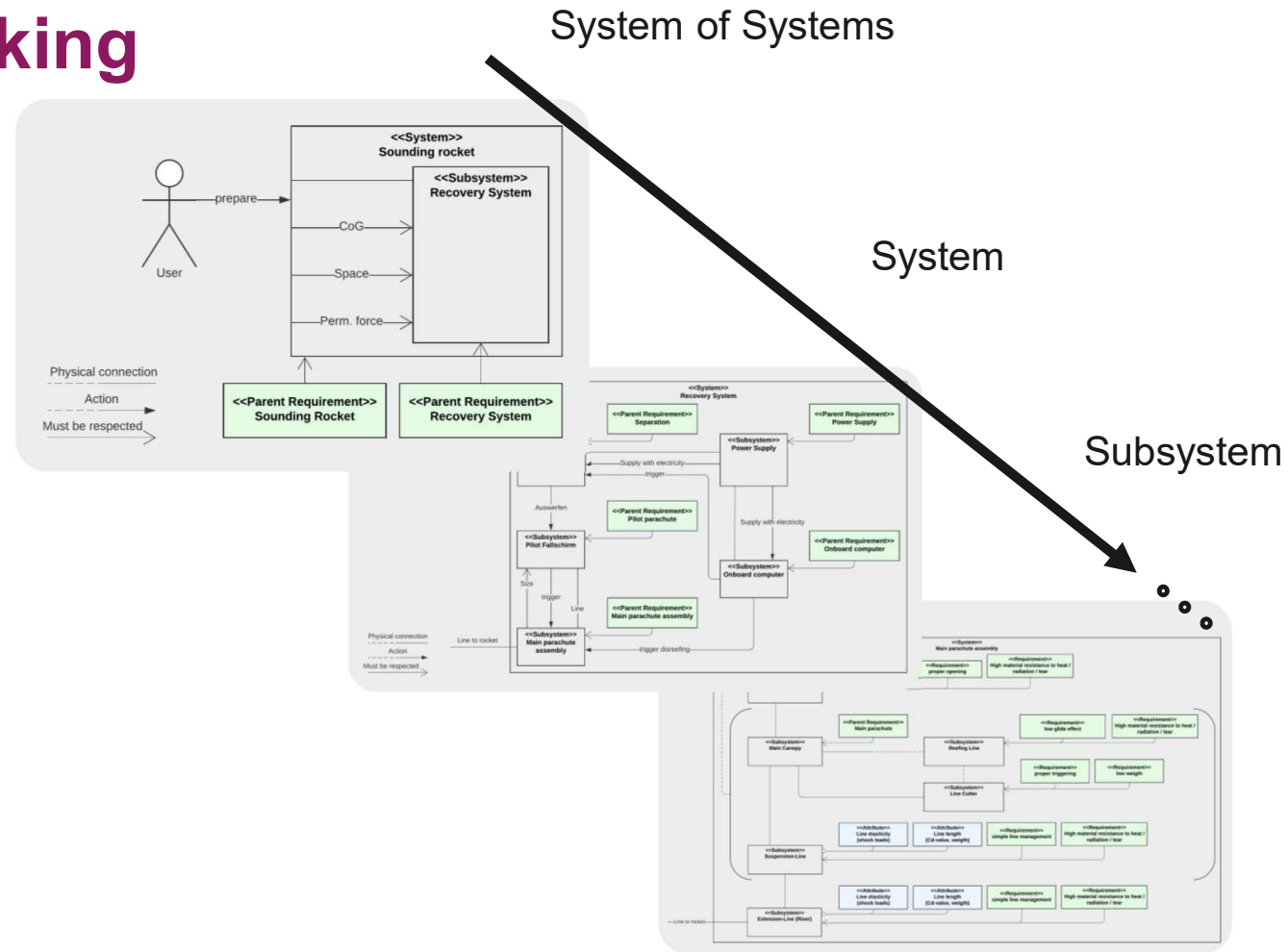
A recovery system is a complex system

- Many requirements and influences have to be balanced with each other
- In order to test these requirements, various tests are necessary



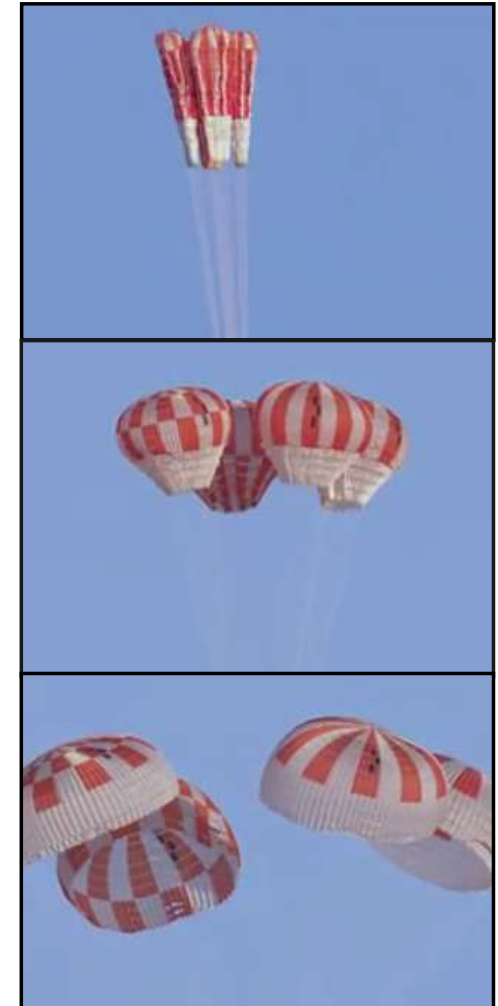
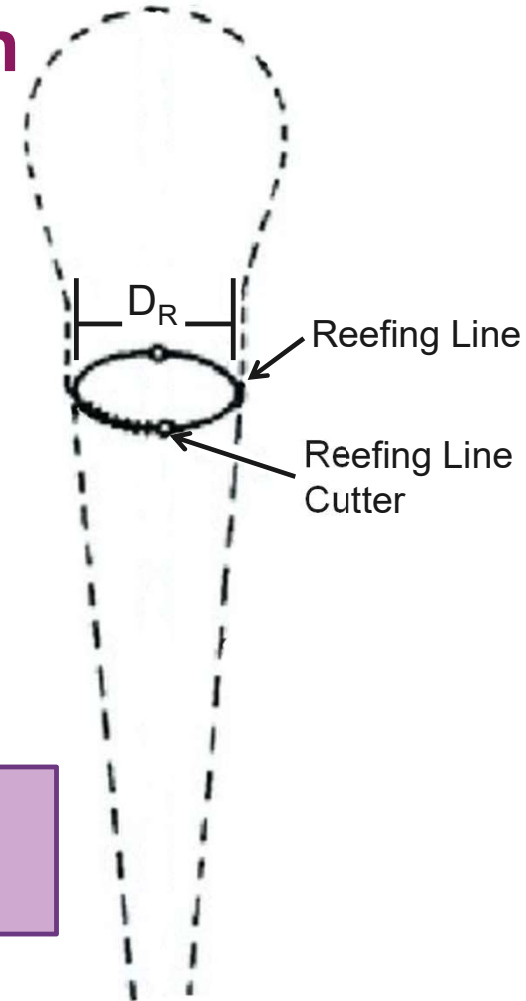
We need system thinking

- To be able to characterize the system in detail, a layer-by-layer description is necessary
- Due to the detailed analysis of the system influences, **it can be specifically modified**



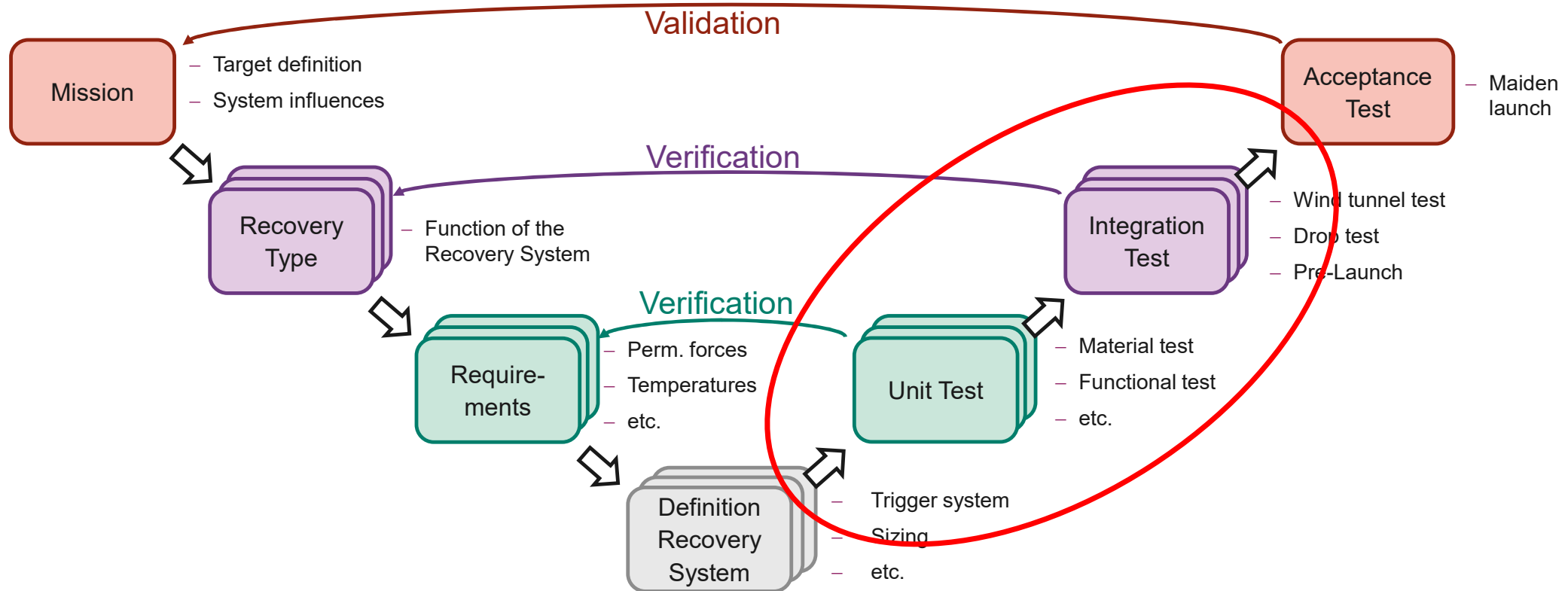
The initial idea for innovation

- Use of a reefed parachute
- Reefing means reduction of the cross section
- Parachute opens in phases



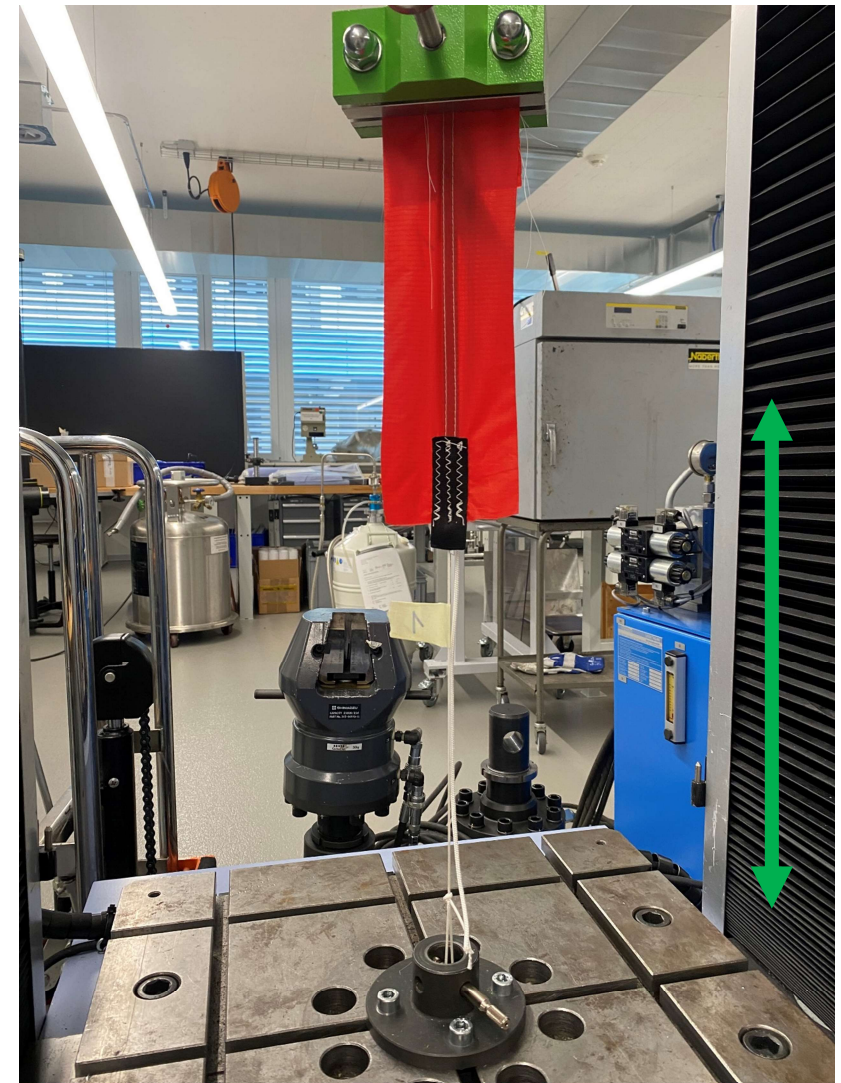
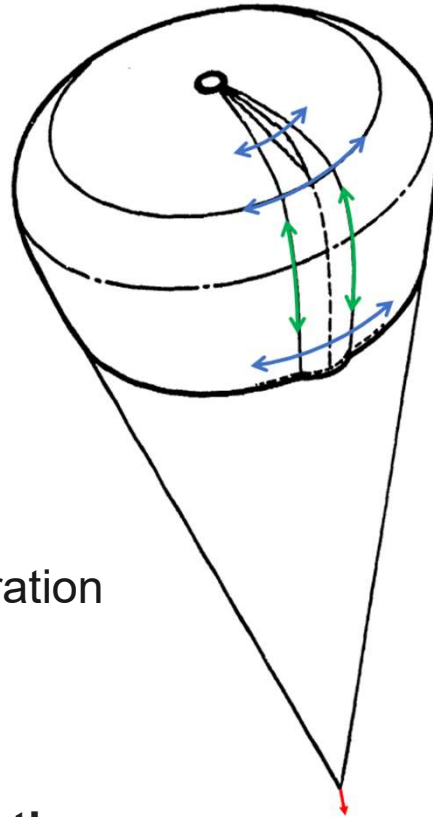
Mechatronic system development

Walking up the V-Model



Textiles unit tests

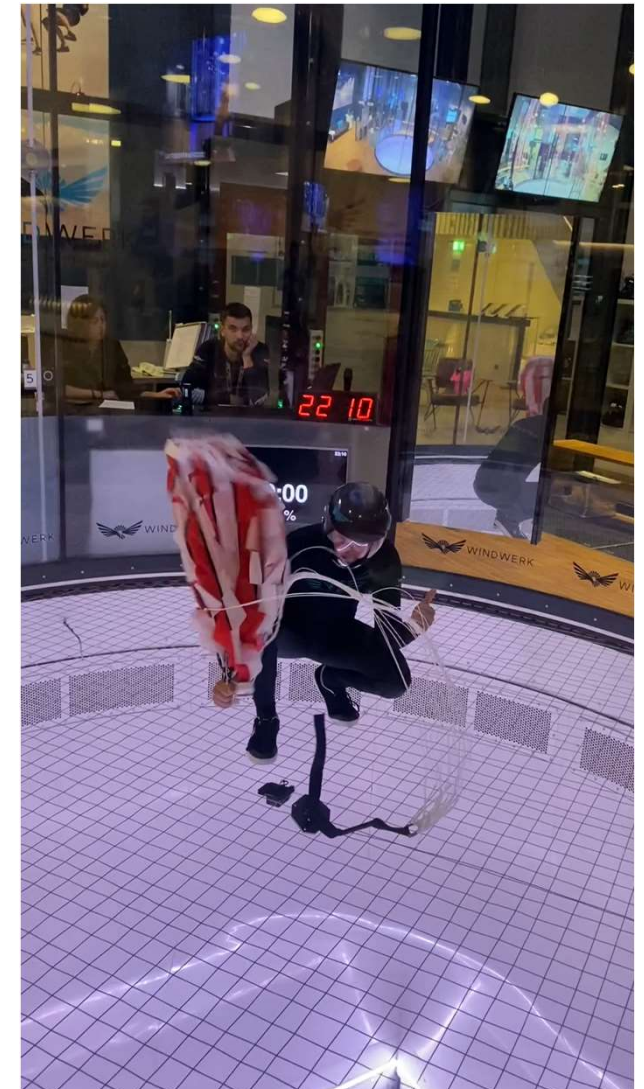
- Analysis in tangential and axial directions
- Inclusion of seams, since perforation reduces strength
- **test makes a statement about the maximum loads and the weakest link**



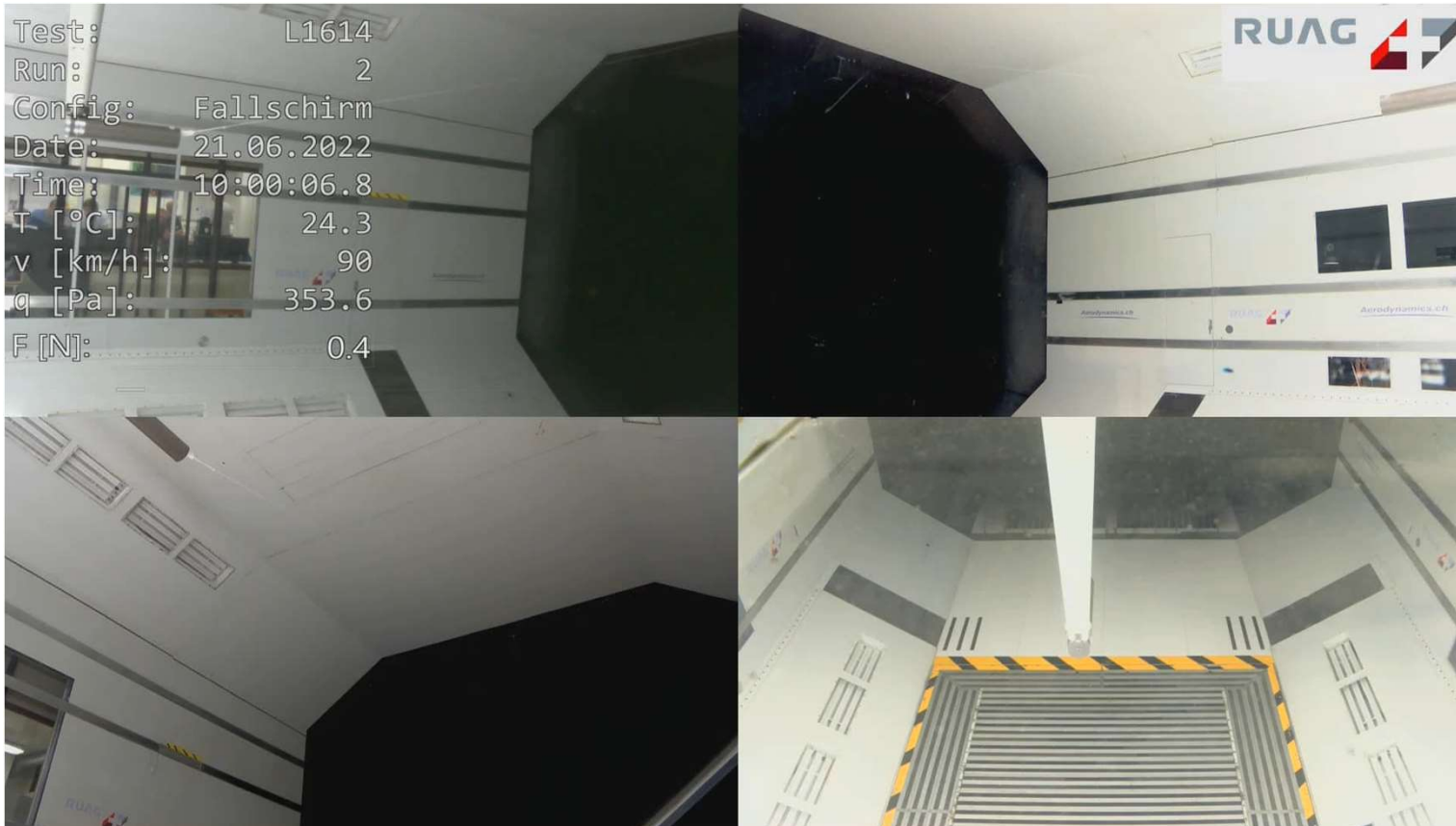
Integration test in a rapid prototyping mode

- Wind tunnel is expensive for testing \Rightarrow approach of rapid prototyping to achieve fast results
- Reliable opening despite line twisting and inversion
- Integration of a reefing line cutter

Functionality of the system is confirmed



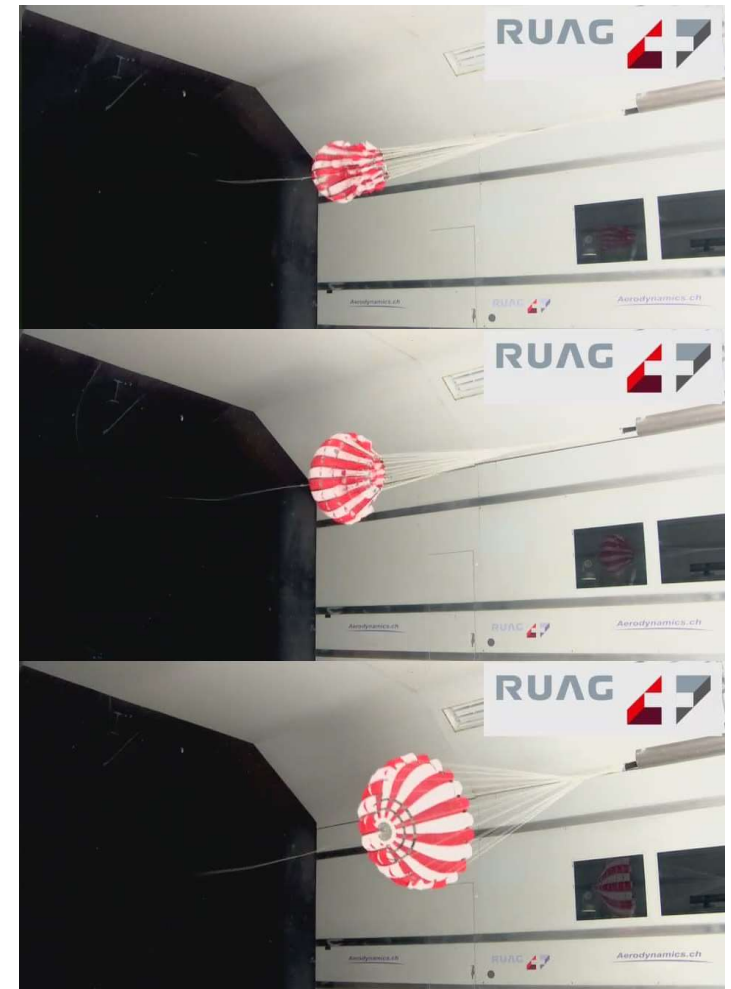
System test in the wind tunnel



- Several test runs in a short time were possible due to a good test concept
- System achieved a high performance in terms of functionality and reliability
- ✓ **Calculations were confirmed by the measurement during the test**

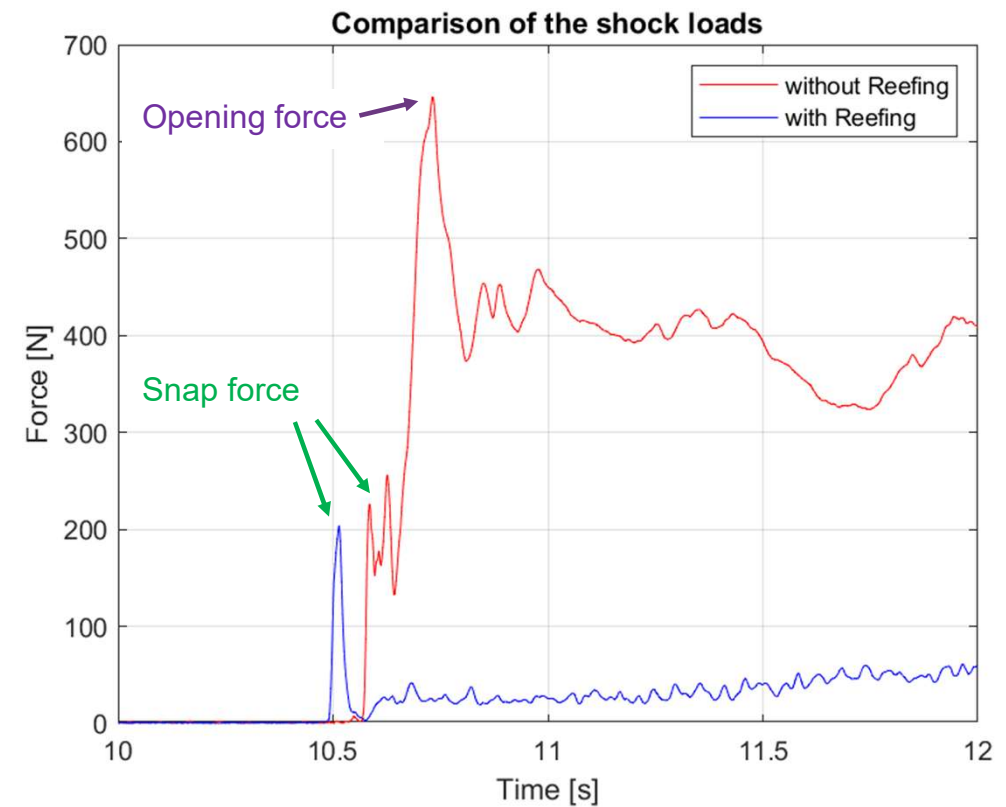
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Requirements and upgrade ARIS

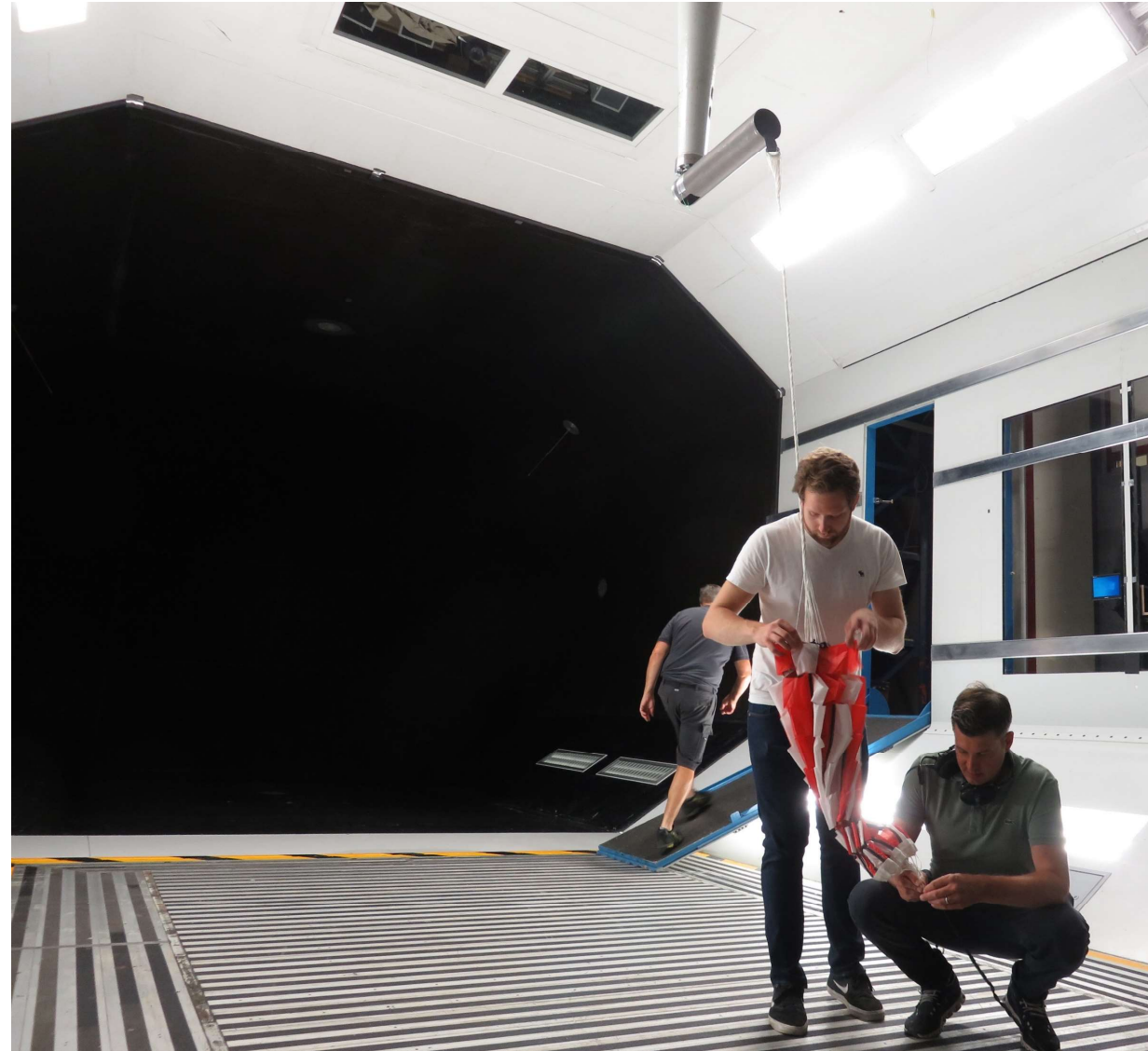
- The opening force has been reduced to a minimum
- Due to the detailed analysis of the data, the system can be specifically modified
- **Results in greater safety and less weight**



Mission statement

Applied system thinking in short time

- Applying the V-Model ensures advanced competencies for work after graduation
- System engineering can already be applied in student work within 30 weeks



We are looking forward to Mars 2028

Thank you for your attention

