Lightweight Multifunctional Probe for Extreme Environment Exploration and Locomotion

TANDEM

NIAC Phase II

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1. **Heat Shield Deployment**
   Tensegrity frame deploys heat shield and back shell.

2. **Peak Aerothermodynamic Heating Loads**

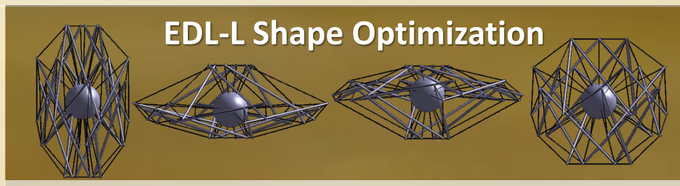
ENTRY

TANDEM Mission Statement

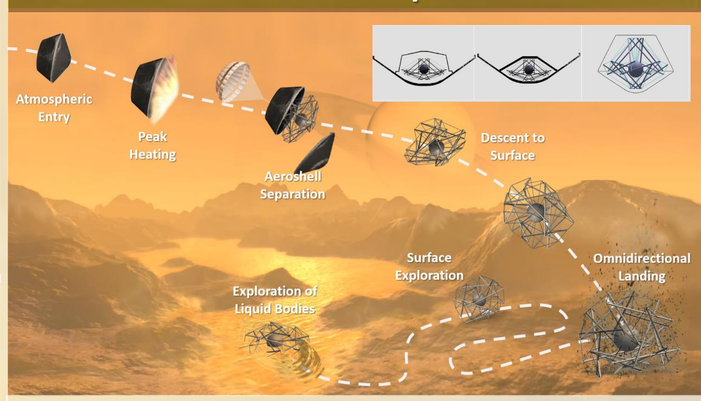
TANDEM is a unified vehicle concept coupling tensegrity robotics with a mechanically deployable semi-rigid heat shield and drag plate, developed to land in and explore the Tessera regions of Venus of scientific priority. All aspects of entry, descent, landing, and locomotion are combined into a single, multifunctional system. The TANDEM architecture is easily adaptable to other exploration missions.

Perception and Identification

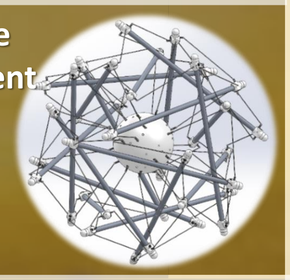
EDL-L Shape Optimization



Alternative Mission Concept: Titan Rideshare

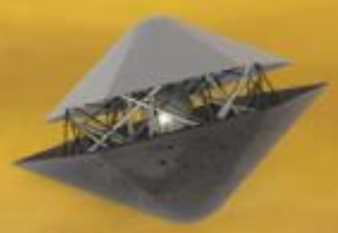


Prototype Development

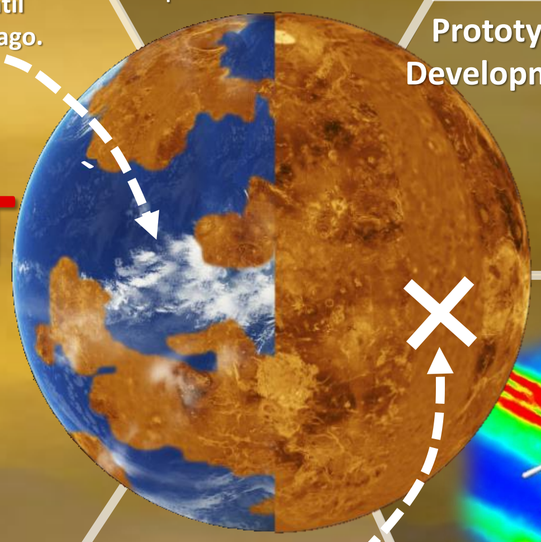


Controller Trained with Neuroevolution

3. **Heat Shield Separation**

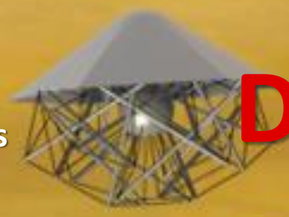


Venus may have had a liquid water ocean and habitable surface temperatures until about 715 million years ago.



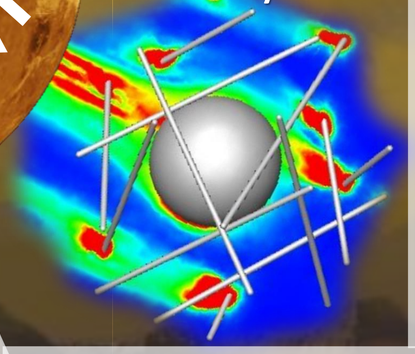
4. **Analysis of Atmospheric Gases**

DESCENT

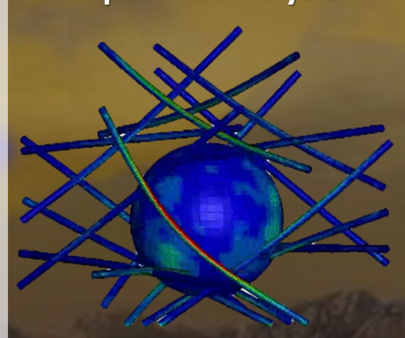


5. **Guided Descent**
   Back shell used to glide towards high science value sites.

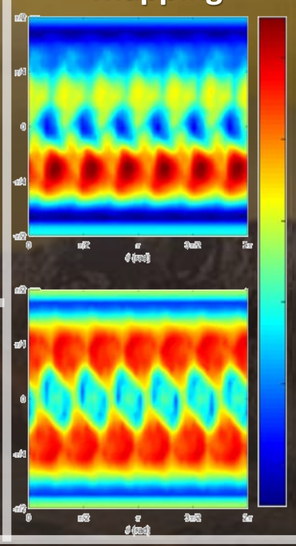
CFD Analysis



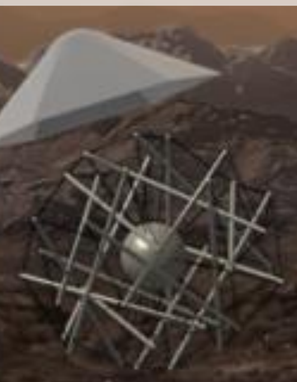
Impact FE Analysis



Impact Orientation Mapping



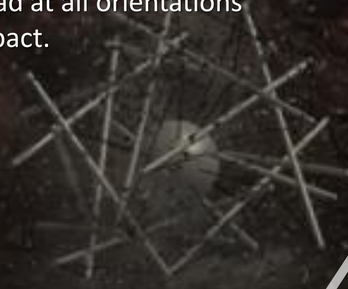
Tesserae are highly deformed geologic features which represent the oldest material on the surface of Venus.



LANDING

6. **Freefall to Surface**
   TANDEM is designed to withstand impact terminal velocity.

7. **Omnidirectional Landing**
   TANDEM protects the payload at all orientations of impact.



9. **Exploration of High Science Value Sites**
   TANDEM perceives its environment and navigates to high science value features such as lava flows and tesserae.

8. **Surface Locomotion**
   Actuation of the cables causes TANDEM to roll.

LOCOMOTION

Acknowledgements

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References

NIAC Phase I Report
Journal of Spacecraft and Rockets TANDEM Report

Venus images courtesy of NASA

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