Using Motion Tracking Camera System In Magnetic Suspension Wind Tunnel Tests For Re-entry Capsules

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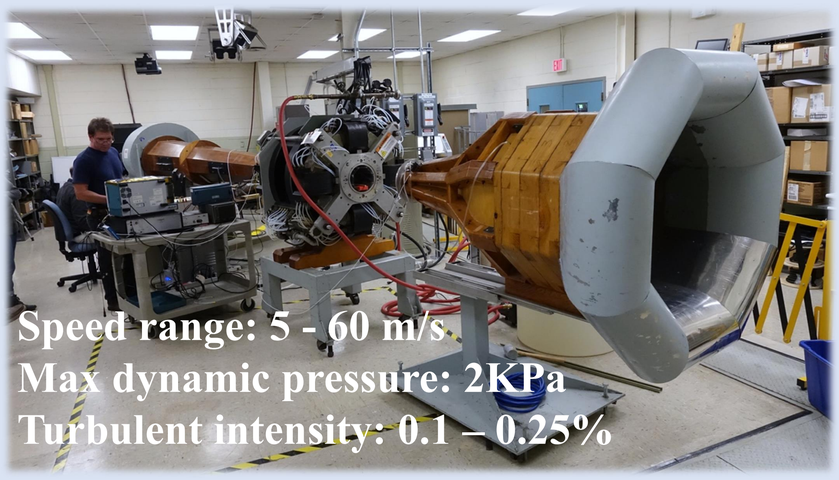
Motivation

- Support aerodynamic testing for levitating 'stingless' atmospheric re-entry capsules
- Enhance system capabilities with motion tracking cameras to test at higher dynamic pressure needed to support CFD and aero-ballistic range testing

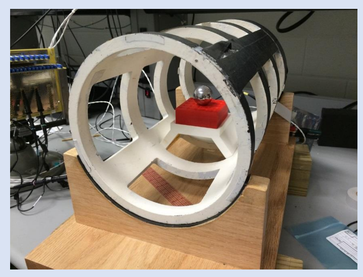
Previously tested models – Stardust & Genesis

Magnetic Suspension Balance System (MSBS)



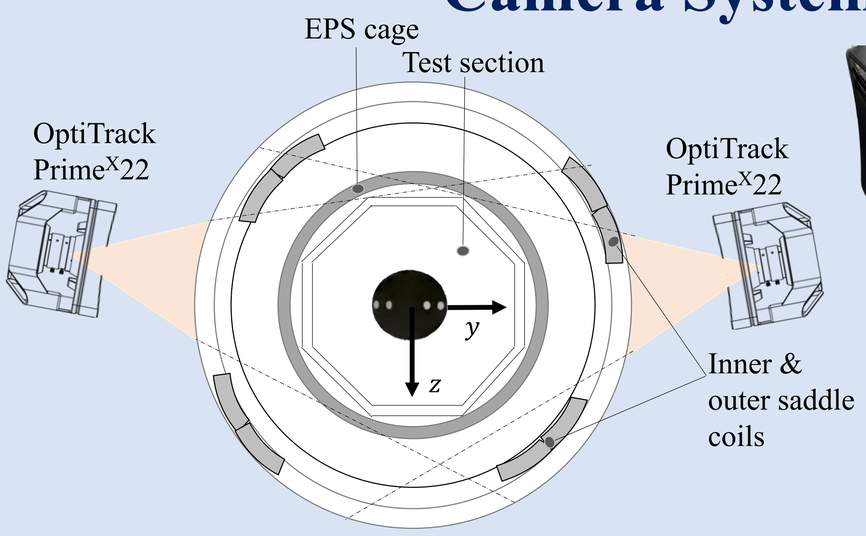
MSBS in subsonic wind tunnel

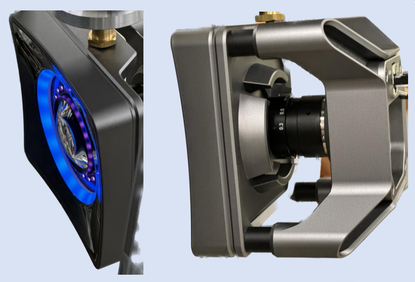
Fitted magnet and coil



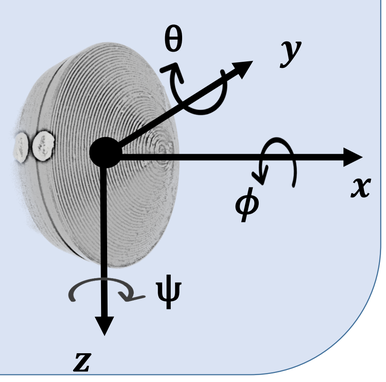
EPS cage – sensing positions

Camera System





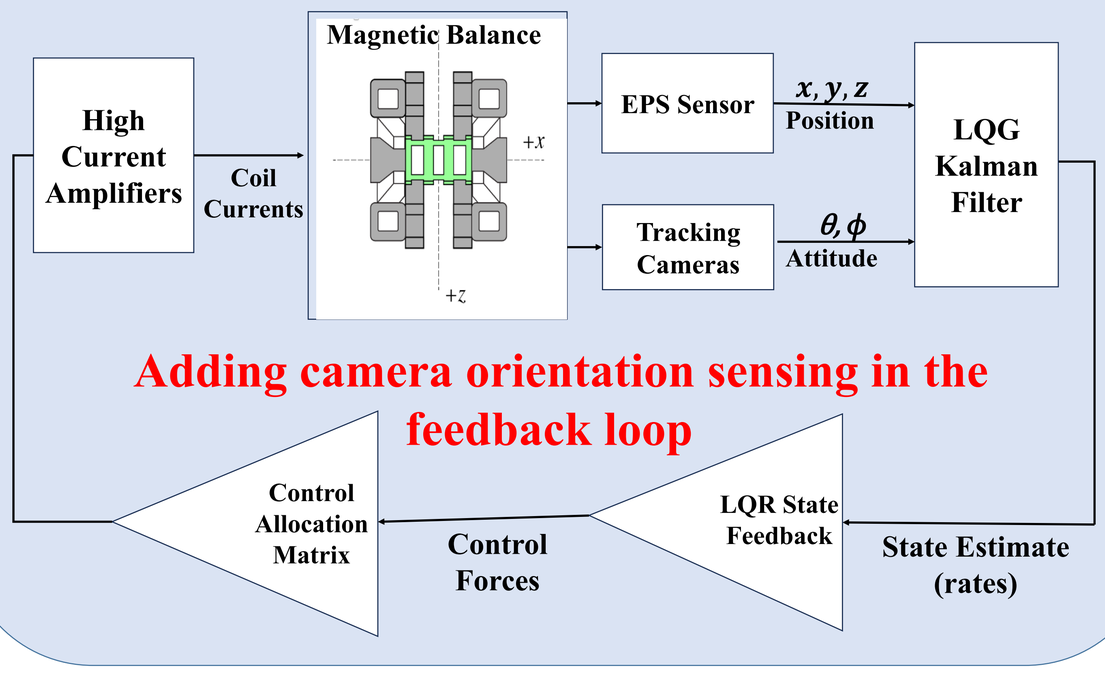
OptiTrack Prime^X22



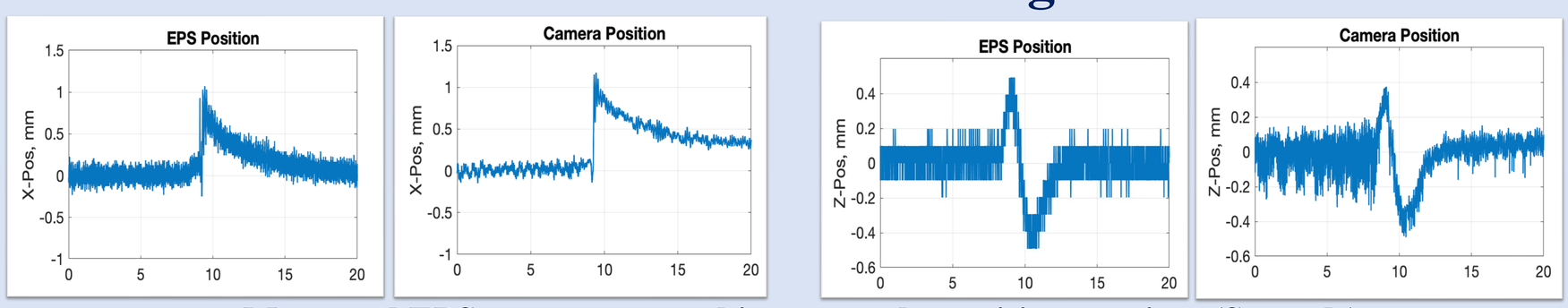
Degree of Freedom (DOF)						
Measuring Unit	x	y	z	θ	ψ	ϕ
EPS	✓	✓	✓		✓	
Camera System	✓		✓	✓		✓

System capabilities – Hybrid MSBS

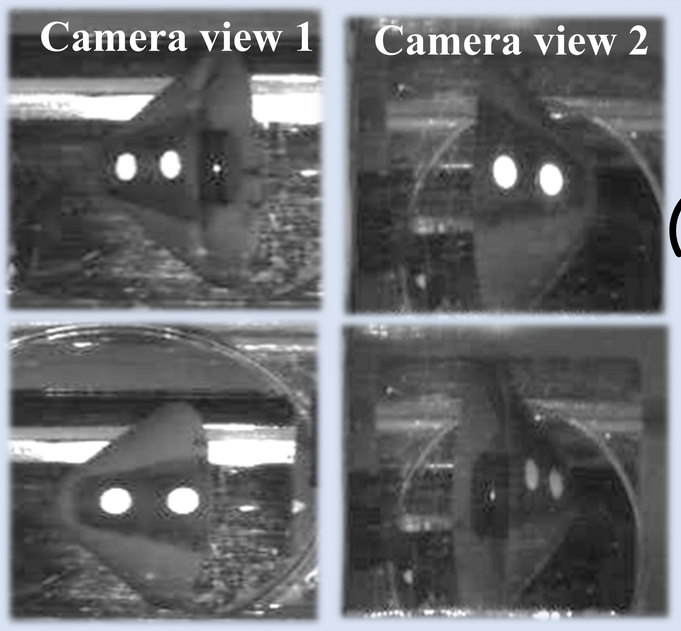
Controller Block Diagram



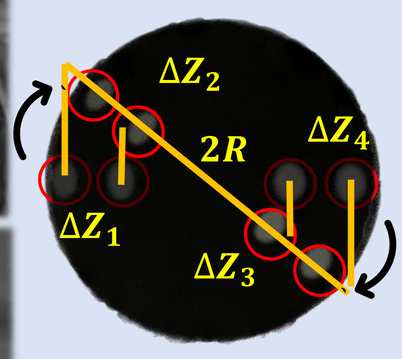
Tracking Results



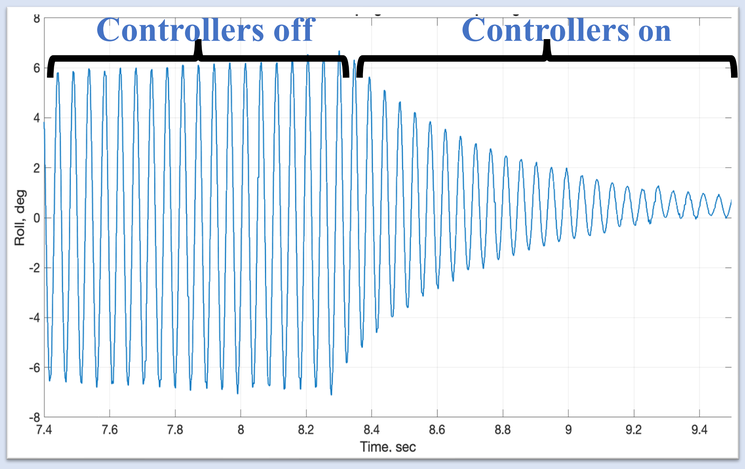
Measured EPS vs camera tracking – x and z positions vs time (Seconds)



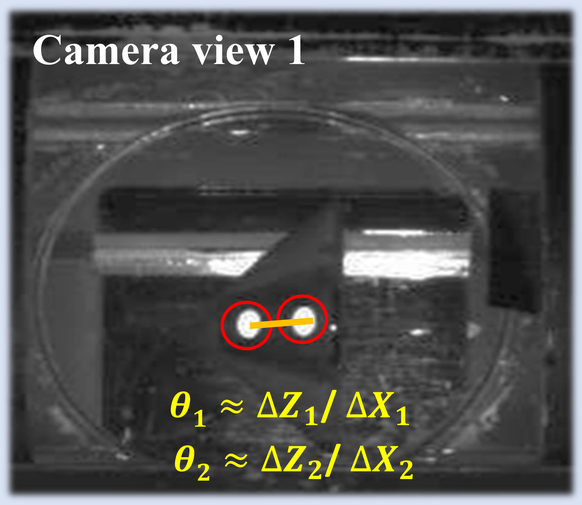
Levitating model

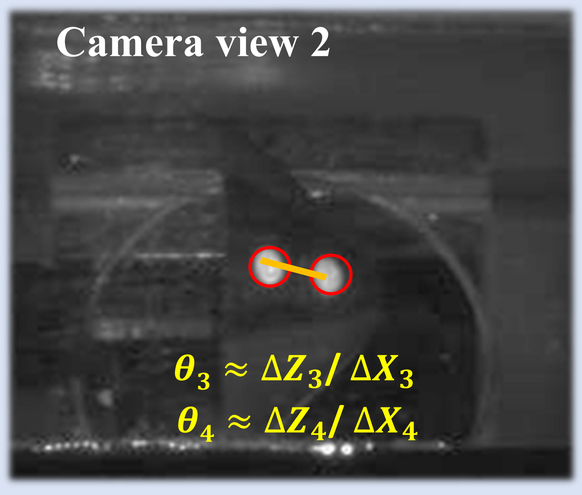


Roll measurement



Active roll damping



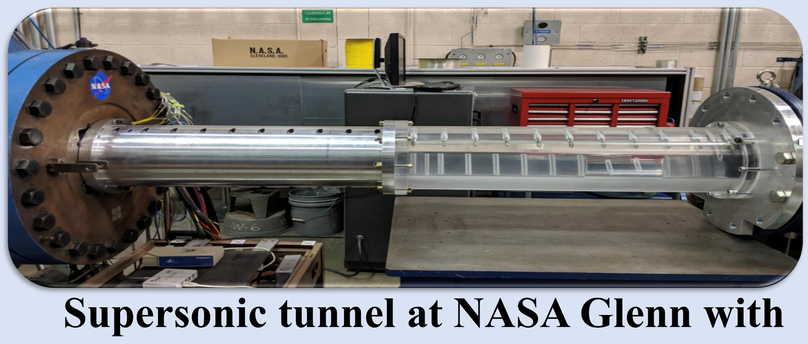


Pitch measurement

Camera tracking algorithm provides real-time roll and pitch information for control

Future Objectives

- Obtain all 6-DOF positions and orientations with the addition of two cameras
- Examine the feasibility of the MSBS in a supersonic wind tunnel at NASA Glenn



Supersonic tunnel at NASA Glenn with octagonal test-section

Acknowledgements

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