

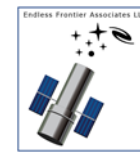
TechMAST: Technology Maturation for Astrophysics Space Telescopes Overview & Year 1 Highlights

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Work performed under contract to NASA for
System Level Segmented Telescope Design (SLSTD) Phase 2 (ROSES 2019-D.13)

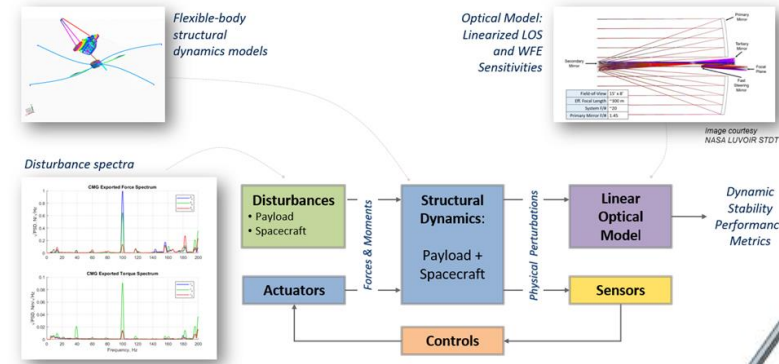
TechMAST Year One Goals and Motivation



The TechMAST goals are motivated by high level requirements for extremely stable telescopes for next generation missions

Integrated Modeling: develop predictions for telescope performance as measured by stability of wavefront error and line of sight pointing

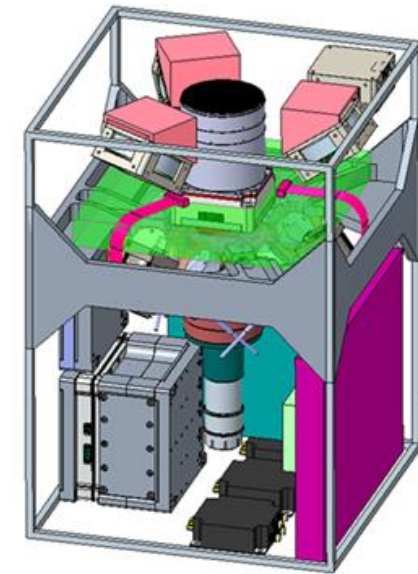
- Study LUVOIR and HabEx incorporating a non-contact interface by investigating the dynamic interaction of flexible structures, realistic disturbances, interface control and linear optical models



Integrated Modeling Process

Disturbance Free Payload (DFP) CubeSat Payload Development: mature non-contact vibration isolation and precision pointing architecture technology through the development of payload design for a space flight demonstration on a 12U CubeSat

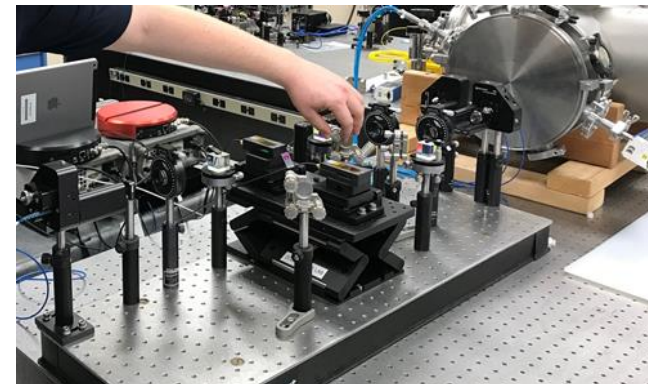
- Non-contact vibration isolation and precision pointing system that is proposed for use on LUVOIR and could be used for HabEx, Explorers, Small Sats and CubeSats



DFP CubeSat

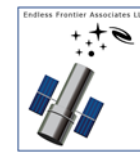
Picometer-level metrology: advance two methods to measure dimensional stability of optic positions within a telescope for both ground verification and on-orbit operational applications

- Heterodyne Metrology (Lockheed Martin): utilizes Photonic Integrated Circuits to measure path distances through optical path phase difference; goal to reduce noise performance over long duration measurements
- Tracking Frequency Gauge Metrology (University of Florida/Illinois Institute of Technology): measures path distance through light frequency changes; goal to develop electronics with a path to flight and improve performance through reducing effect of spurious Amplitude Modulation

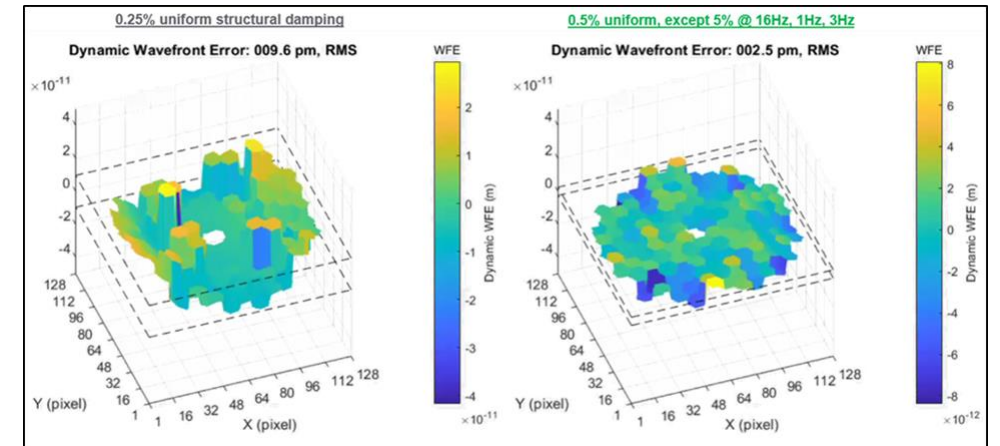
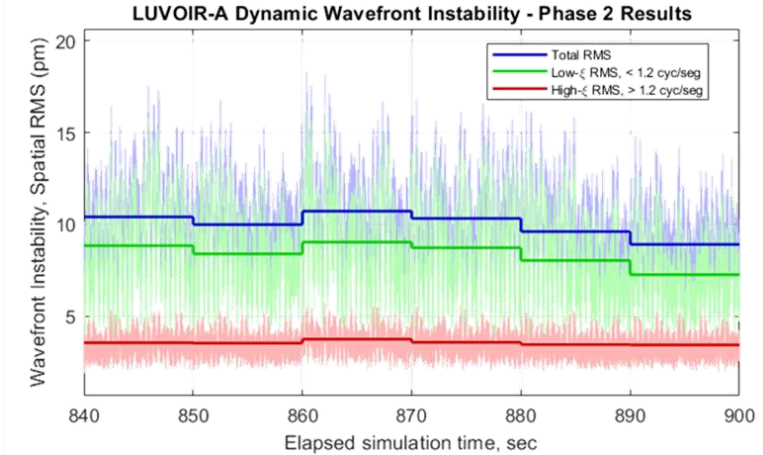


Picometer Metrology Testbed

Integrated Modeling Key Results



- LUVOIR-A 15 m design is compliant with WFE stability of 10pm
 - Realistic architecture parameters assumed and allocated portions of the WFE stability budget
 - Wavefront error stability defines the critical system design elements such that if the architecture parameters meet the WFE stability then the LOS stability meets the 0.3 milli arcsecond requirement with 68% margin
- LUVOIR-A WFE is sensitive to characteristics of a small number of payload structural modes
 - As an example: an increase in structural damping from 0.25% to 0.5% uniformly and a 5% increase in three specific modes reduced WFE instability from 10pm to 2.5pm RMS and reduced coronagraph contrast instability from $4e-11$ to $2.0e-12$
- A HabEx observatory incorporating a non-contact vibration isolation and precision pointing system showed compliance with the HabEx LOS stability requirements with a factor of 10 margin and achieved comparable WFE performance as the micro-newton thruster based HabEx design.
 - The model assumed conservative assumptions on structural damping, interface cable damping, and hard-mounted Control Moment Gyros on the spacecraft bus.



LUVOIR A Study shows opportunity to improve Dynamic WFE Stability through targeted structural design improvements

Full Report of TechMAST Year 1 results will be posted here: <http://www.astrostrategictech.us/>

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