IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (9)

Author: Dr. Ye Zhou
Dynamic Intelligent Structures Ltd., Canada, ye.zhou@dintels.ca

Prof. Jeff Kuhn
University of Hawaii, United States, jeff.reykuhn@yahoo.com
Dr. maud langlois
CNRS, France, maud.langlois@univ-lyon1.fr
Dr. Gil Moretto
CNRS, France, Gil.Moretto@univ-lyon1.fr
Prof. Rafael Rebolo
Instituto de Astrofisica de Canarias, Spain, rrl@iac.es
Dr. Nicolas Lodieu
Instituto de Astrofisica de Canarias, Spain, nlodieu@iac.es
Mr. Kevin Lewis
Buble Studios, United States, kev.lew.hi@gmail.com

SMALL-ELF TELESCOPE - STRUCTURAL APPLICATION OF TENSEGRITY AND OTHER TECHNIQUES FOR LARGE, LIGHT-WEIGHT TELESCOPES

Abstract

Small-ELF is a 3.5-meter telescope currently in development that will serve as a technology demonstrator for the much larger telescope named ELF (ExoLife Finder). The ELF is proposed to be built with a minimum effective diameter of 12-meters and is designed to be scalable to a much larger size. The primary objective of the proposed design approach is to radically improve the system's capabilities for direct-imaging of exoplanets while keeping costs well below the current flagship observatories. As a technology demonstrator, the mechanical design of Small-ELF intends to deliver a versatile and reliable experimental platform to implement and verify several new techniques: the use of a tensegrity-based configuration for a light-weight supporting structure, the use of tensioned ropes to actively adjust the telescope geometry, methods of accommodating sub-apertures of significant weight variations, and methods of controlling and mitigating vibrations associated with light-weighted structures through active and passive damping systems. The design also adopts techniques for efficient precision manufacturing and cost control. The unique optical layout and application of tensegrity produce significant weight and subsequent cost reductions. This technology demonstrator tackles the cost and scalability problem faced by most existing telescopes and intends to open a new chapter in large telescope structural design methodology. The developed techniques for very large telescopes also synergize with the receiver design for Breakthrough Starshot, a research and engineering program aiming to demonstrate proof of concept for a new technology, enabling ultra-light uncrewed space flight at 20% of the speed of light; and to lay the foundations for a flyby mission to Alpha Centauri within a generation. The tracking receiver mechanics in current large telescopes has costs comparable to the optical energy concentrator payload. This necessitates the development of technologies and a roadmap to reduce the receiver system cost by orders of magnitudes.