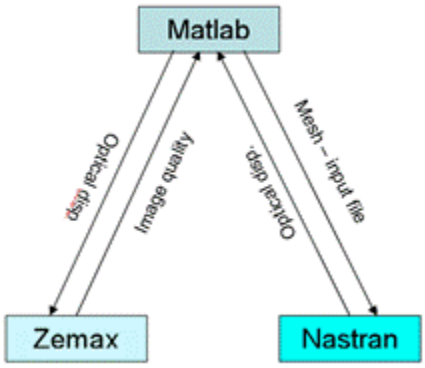
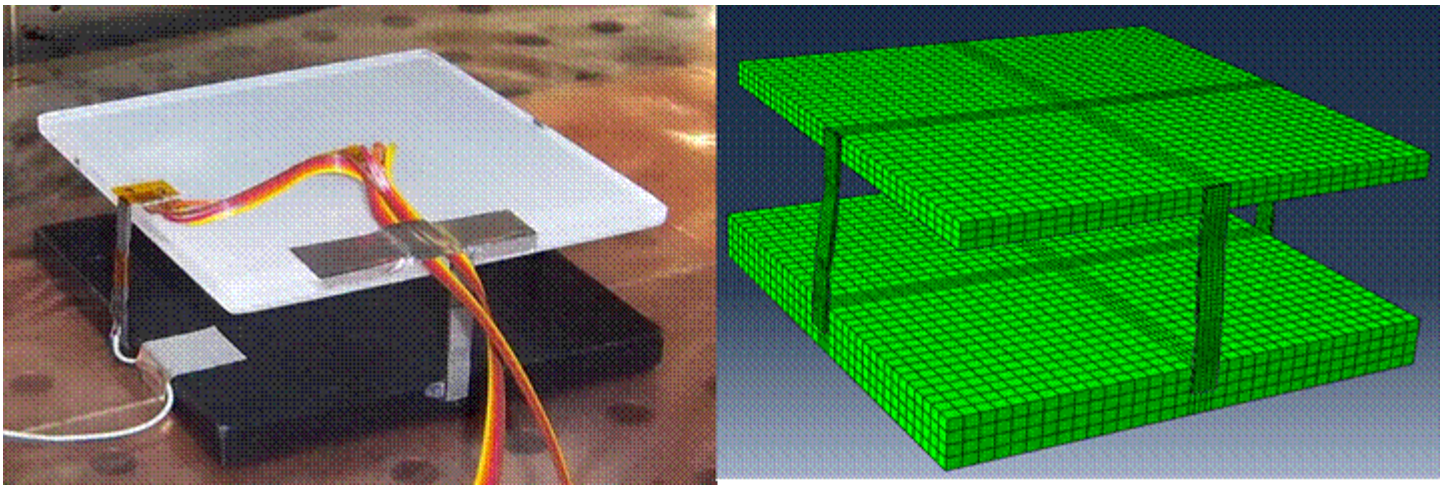
Thesis Proposal - Optomechanical design: integrated models and Structural Optimization



FEM + Raytracing integrated framework design

The design of astronomical instrument is growing in dimension and complexity following ELT class telescopes. The availability of new structural material like composite ones is asking for more robust and reliable designing numerical tools. This thesis wants to push on the activity started at Osservatorio Astronomico di Brera regarding optomechanical design by upgrading the in house developed integrated design framework. The procedure starts from the developing of a raw structure consisting in an assembly of plates and beams directly from the optical design. The basic Finite Element Model is then prepared joining together plate and beam elements for the structure and mass and semi-rigid element for the the opto-mechanical subsystems. The technique developed is based onto Matlab; commands and run the FEA, extrapolate the optical displacements, implement them into the optical design and evaluates the image quality in terms of displacement and spot size. Thanks to a simplified procedure the routine is able to derive the full field of displacements from a reduced sequence of three different load sets. The automatic optimization routine modifies the properties of plates and beams considering also different materials and, in case of composites different lamination sequences. The algorithm is oriented to find the best compromise in terms of overall weights w.r.t. eigen-frequencies, image stability and quality.

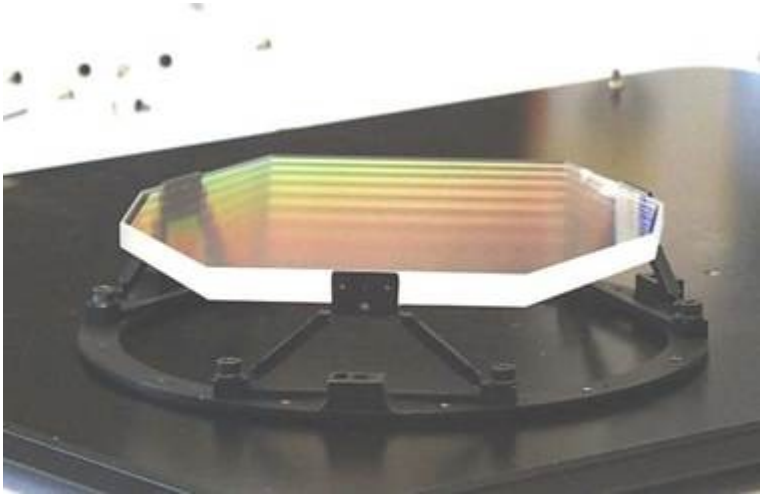
Thesis Proposal – Shape Memory Alloys for Astronomical Instrumentation



SMA optomechanical Mounting example (Experiment left and FEM right)

It will be inserted in the current research activity devoted to this argument. This thesis wants to investigate possible applications of Shape Memory Alloy (SMA) as functional devices for space and ground based application in Instrumentations for Astronomy. Thermal activated Shape Memory Alloys are materials able to recover their original shape, after an external deformation, if heated above a characteristic temperature. If the recovery of the shape is completely or partially prevented by the presence of constraints, the material can generate recovery stress. Thanks to this feature, these materials can be positively exploited in Smart Structures if properly embedded into host materials. Some technological processes developed for an efficient use of SMA-based actuators embedded in smart structures tailored to astronomical instrumentation have been already developed at Osservatorio Astronomico di Brera in collaboration with Politecnico di Milano and will be developed in this framework. Some possible modeling approaches of the actuators behavior will be addressed taking into account trade-offs between detailed analysis and overall performance prediction as a function of the computational time. The Material characterization procedure adopted for the constitutive laws implementation will be taken into addressed as well. This thesis work will then deal with shape memory alloys and their possible introduction into the design/manufacturing of optomechanical mounts mainly for Astronomical Instrumentation. It will combine sperimental And Numerical Activities dealing with non-linear analysis and user defined constitutive laws.

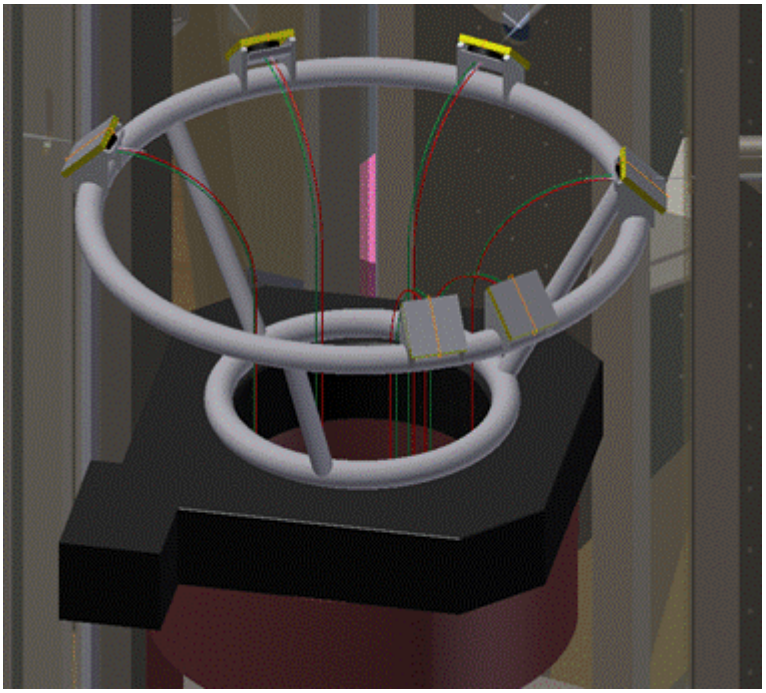
Thesis Proposal - Kinematic mounting for Astronomical optomechanical components



Example of kinematic bipodal mounting (GALEX grism mounting)

This thesis work will deal with the parametric design and testing of kinematic mounting for thermoelastic compensation of optomechanical components of space and ground based Instrumentation for astronomy. The Parametric Finite Element analysis will be coupled with the realization and testing of representative prototype. The activity belongs the projects of Engineering Team at Astronomical Observatory of Brera (Milano). The group has extensive experience in design, manufacturing, integration and testing of optomechanical components and Instruments for astronomy both space and ground based.

Thesis Proposal - Breadboarding activity of the Espresso Front End @ VLT



Toggling system concept design

This thesis work will deal with the Breadboarding activity of the Toggling system for Espresso Front End @ VLT. The toggling system will provide Espresso model selection. It will position the Fiber Injection systems in front of the Front End modules. It is made by a rotary stage mounted onto a cylindrical support. The rotary stage will held a structure that host all the Fiber Injection System and the shutters. It has been selected the Micos Precision DC-Motor actuated Rotary Stage PRS-200 that have a rotor with a clearance of 120mm diameter and a resolution of 0.001°. In the Fiber Injection system it will be introduced a shutter system that must be equipped with an external status (open Vs closed) sensor.

The thesis activity shall cover the following activities:

- Finalize the design of the Toggling system prototype and follow its procurement;
- Design the test set up to measure the repeatability performance and its lifetime degradation;
- Execute the test;
- Conceive and test the shutter status sensor integration.