**RESEARCH TOPICS**

**Title:**
*HEAT AND MASS TRANSFER INTO THERMAL PROTECTION SYSTEMS WITH ABLATIVE MATERIALS IN AEROSPACE APPLICATIONS*

**Posed problems**
When exposed to extreme heat fluxes, the ablative material absorbs large amounts of heat, changing its physical state. Some materials will also undergo chemical changes prior to ablate.

**Research Project Objectives:**
Develop a computation tool able to support the design of an entry vehicle thermal shields in terms of material selection, thickness and shape evaluation, by carefully modelling, with suitable and accurate discretization techniques, the physical, chemical and heat transfer phenomena involved in the charring, ablation and surface regression processes.

The numerical discretization of the models by utilizing the Finite Element Method in 1D and 2D geometries can take great advantage by the application of adaptive methods for the choice of an optimal space discretization and time-stepping. Moreover, the use of modern methods like level set methods can provide a useful and accurate description of the internal moving fronts in the material and of the real geometry of the shield at each time. Optimization techniques, based on the previously described accurate discretizations will be improved in combination with the CFD codes and models developed by the POLITO DIASP parallelly.

**Ph.D. themes**
1. Improvement of heat transfer model for the behaviour of porous, high temperature thermal insulating materials in Entry Descent and Landing phase conditions.
2. Development of an innovative strategies for simulating the heat shield behaviour using new 2D, 2D axialsymmetric ed full 3D codes, coupled with CFD code proposed by the Aeronautical and Space Engineering Department.
3. Development of an Ablation code by using FEM approach to describe thermal, chemical and mass diffusion inside the heat shield.
4. Project and numerical simulation of an arc-jet for testing ablative materials.

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REFERENCE PAPERS


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