Optimization of a Structure under Intense Thermal Radiation and its Self-Weight

Nicolau José Moreno Velez[†], Miguel António Lopes de Matos Neves* and Hugo Filipe Diniz Policarpo[†]

[†] Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico,
Universidade de Lisboa, 1049-001 Lisboa, Portugal
E-mails: hugo.policarpo@ist.utl.pt, nicolau.velez@tecnico.ulisboa.pt

[*]LAETA, IDMEC, Instituto Superior Técnico, Universidade de Lisboa
Avenida Rovisco Pais, 1049-001, Lisboa, Portugal
Email: miguel.matos.neves@tecnico.ulisboa.pt

ABSTRACT

This proceeding is dedicated to the optimization of thermoelastic structures under thermal radiation and its self-weight, involving thermal conductivity but not convection. For the analysis, it is used a thermal-structural finite element module of a commercial FE program where the radiation is modelled through view factors between elemental surfaces. The thermostructural problem under the assumption of small deformations is then treated as weak coupling problem. Limitations of the available tools are briefly discussed. For the optimization, a SIMP topology optimization (TO) is used to find optimized material distributions along a given spatial domain. The objective is to achieve both lower maximum temperature along the structure as well as lower maximum displacement. Some examples of results are presented for the long hollow truncated rectangle metallic pyramid analyzed. The known effect that TO tends to remove most of the material in the design areas is firstly analysed. It is also presented a study of adding uniform coverage in thickness to reduce the maximum temperature and displacement, which resulted in an optimized solution with a small step near the end of the pyramid directly exposed to the radiation source. This somehow unexpected result is discussed.

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