Physico-mechanical approach for non-linear modeling of filled elastomers

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Helicopter drag damper made by Hutchinson

- Mechanical characterization (formulation dependency, combined solicitations shear-compression)
- Physico-mechanical non-linear modelling (multi-scale)
- Homogenization (micro to macro)
- Numerical simulation (Zset, Numea)

Abstract:

Filled elastomers' mechanical properties are very interesting in a large temperature and frequency range. Those are of prior importance for vibration dampers applications in automotive or even value-added application in aeronautic. Mechanical prediction of those materials is compulsory for Hutchinson for industrial designing.

In fact, reinforcements – especially nano-silica which are very compatible with silicone – drastically improve mechanical properties (stiffness, ultimate strength, abrasion, absorption…). In return, some dependencies and non-linearities (invisible in pure matrix) occur in the mechanical behavior which make the finite element analysis very complex.

In this context, we aim at building a robust physico-mechanical model consistent with experiments. Two objectives for this thesis:
- Helping formulation of new materials by multi-scale simulation of micro-structures.
- Quantitative finite element modeling and prediction of non-linear mechanical properties of filled elastomers in order to design new vibration damper structures in aeronautic.