Thèse de doctorat à l'Institut Pprime, Université de Poitiers, France

Study of the mechanical properties of porous complex structures (combination of a solid deformable structure with a high porosity, soaked with fluid) by optical full-field methods

Keywords:

Porous structures, soaked foams, compression, optical method, X-Ray microtomography, Digital Image Correlation, Digital Volume Correlation, strain micromechanisms, XPHD

The performance of many industrial applications is largely based on the quality and reliability of the guidance and support systems (high rotational speeds, low friction torque, damping capability, etc.). This PhD work is a part of an ANR (French National Research Agency) project entitled SOFITT (Saturated Open-pore Foams for Innovative Tribology in Turbomachinery). The aim of this project is to find innovative technical solutions that break with current practices and provide high-performance support systems in terms of load capacity and damping. The project proposes a new concept of lubrication and correspondingly a new material (understood as a complex/composite material formed by the solid porous structure –compressible porous layers- and the imbibing fluid) in order to improve the quality and reliability of guidance and supporting systems.

The goal of this PhD work is to study, to understand and to quantify the mechanical behavior of porous complex imbibed structures linked with their microstructure and properties of fluid by using adapted loading devices, non-contact optical full-field techniques and identification methods.

The first step of this work is to choose the good candidates of porous materials and fluids compatible with features of the project and to evaluate the possibilities of different devices which can be used for their analysis. Once these data have been defined, the characterization of the mechanical behavior of the studied materials will be carried out by two ways: firstly, highly porous media with three-dimensional microstructure without fluid will be studied and secondly, fluid/structure interaction will be evaluated under dynamic loading conditions. A quasi-static 3D investigation of the mechanical behavior of the material will be performed by using 3D X-ray microtomography, image analysis tools and Digital Volume Correlation technique, and 2D simplified samples will be investigated dynamically by using Digital Image Correlation. The two steps envisaged are intended to decouple the dynamic and static effects in order to facilitate the understanding of physical phenomena but also to validate the models built in another PhD work, part of the same SOFITT project.

This work will take place within the Pprime Institute, more particularly in the TriboLub and PEM teams of the GMSC department. The PhD student sought is a student graduated from engineering school or Master, with good skills in mechanical engineering and a strong taste for material mechanics. The candidate should lead a PhD work with a great experimental aspect, the development of loading and investigation devices. An experience in optical full-field measurement methods will be appreciated. The student will be rewarded according to the legal provisions throughout the duration of his thesis.

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