

Plan of Dissemination of Knowledge

Green Aviation – Manufacture

Failure Modeling of Composites and Nano-filler enhanced Composites

Graduate Program in Aeronautical and Mechanical Engineering
Aeronautical Design, Structures and Aerospace Systems (PG/EAM-1)

Proponents: Dr. Alfredo R. de Faria, Prof., ITA
Dr. Ragnar Larsson, Prof., Chalmers

Innovative knowledge searched

The knowledge to be acquired in this project is complimentary to the knowledge already in place at ITA, i.e., how to model multifunctional composites based on Graphene nano-Platelet (GnP) enhanced polymer (epoxi). The first step in the modeling consists in predicting stiffness properties of graphene based composites. The second step, more challenging, consists in predicting strength properties. The first step can be tackled through homogenization procedures that are straightforward. The second step, however, requires development of specialized damage mechanics models, which will be based on pre-existing damage models already available at ITA.

Dissemination of knowledge at ITA

Internal knowledge spread is also important, e.g. in the form of seminars, workshops and technical meetings to be held with ITA graduate students. Moreover, the knowledge acquired will be an essential part of doctoral theses to be developed. Topics that are particularly relevant are: (i) failure of composites under longitudinal compression, (ii) failure of composite bolted joints enriched with GnP, (iii) new composite finite element formulations with through the thickness capabilities.

Expanding the ITA teaching activities

The development of the ITA teaching relationship can be developed on several fronts by:

- widening the master student exchange between ITA and Chalmers in the area of composite mechanics, in particular, related to the proposed research issues.
- initiating doctoral student exchange based on already existing activities within the scope of the working plan.
- initiating a common ITA/Chalmers project, e.g. involving doctoral students and supervisors from both universities.
- taking part in the co-supervision of doctoral student projects.

Joint ITA/Chalmers publications

An important part of the scientific work is to spread the knowledge of the developed research ideas and results, thereby promoting the proper relevance and feedback to the involved researchers and institutes. We will actively work for publication of the research at conferences (papers/oral presentations) as well as journal publications.

Team members

Currently, six people participate in the project. They are:

- 1) André Schwanz de Lima, third year doctoral student at ITA, working on new composite finite element formulations with through the thickness capabilities.
- 2) Sergio Augusto Capasciutti de Oliveira, fourth year doctoral student at ITA, working on failure prediction in fiber-reinforced composites under longitudinal compression.
- 3) Dr. Maurício V. Donadon, Assoc. Prof. in the area of composite damage mechanics at ITA.
- 4) Dr. Alfredo R. de Faria, Prof. in the area of composite aerostructures at ITA.
- 5) Dr. Ragnar Larsson, Prof. in the area of computational material mechanics at Chalmers.
- 6) Dr. Linnéa Selegård, Adjunct Senior Lecturer in the area of nanoscience at Linköping University/SAAB.

Additional ITA graduate students are expected to join the project provided they are approved in the entrance examination for the Graduate Program in Aeronautical and Mechanical Engineering to be held on 04/Nov/2019.

As a result of the collaboration three articles have been accepted for oral presentation:

[1] de Faria AR, Larsson R. Failure induced by instability in structural composites under longitudinal compression. *Aerospace Technology Congress 2019*, 8-9 Oct., Stockholm, Sweden, 2019.

[2] Oliveira SAC, Larsson R, Donadon MV, de Faria AR, Selegård L. Failure prediction in fiber-reinforced composites based on continuum damage mechanics. *7th ECCOMAS Thematic Conference on the Mechanical Response of Composites*, 18-20 Sept., Girona, Spain, 2019.

[3] Lima AS, de Faria AR. Assessment of different local interpolations for a global-local superposition 2D finite element. *25th International Congress of Mechanical Engineering*, 20-25 Oct., Uberlândia, MG, Brazil.