Multibody & Mechatronic Systems Laboratory
Department of Aerospace & Mechanical Engineering
www.ltas-mms.ulg.ac.be

Liège, June 24, 2022

Job Announcement

"Mesoscopic modelling and simulation of wiring harnesses"
(THREAD ESR 3)

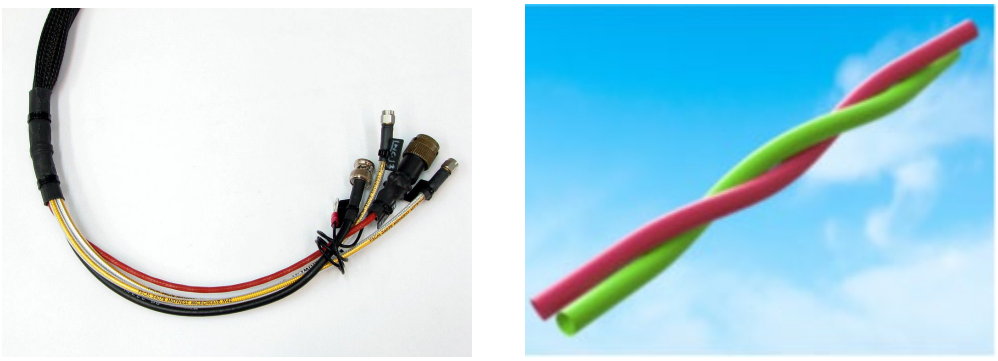

Fig. 1 Example of a cable harness and illustration of a beam-to-beam contact model [1].

Practical aspects

- **Laboratory**: Multibody and Mechatronic Systems Laboratory of the University of Liège, Belgium (www.ltas-mms.ulg.ac.be).
- **Supervisor**: Prof. Olivier Brüls (o.bruls@uliege.be).
- **Duration**: full-time PhD position starting from August 16th, 2022 (or later), and limited for 36 months. During the first 19 months, the position is funded by the THREAD project (see details below). For the next 17 months, the position will be extended by a "Stipendium" granted by Fraunhofer ITWM in Kaiserslautern.
- **THREAD project**: during the first 19 months, this "early stage researcher" position is offered within the EU Marie-Skłodowska-Curie Innovative Training Networks in the project "*Joint Training on Numerical Modelling of Highly Flexible Structures for Industrial Applications [THREAD]*", see https://thread-etn.eu/.
- **THREAD salary**: during the first 19 months, the salary follows the regulations set by the European Commission. It includes social security and is composed of living, mobility and family allowances, where applicable, as outlined in the Grant Agreement and Horizon 2020 Marie-Skłodowska-Curie Actions Work Programme, please see here: https://ec.europa.eu/research/mariecurieactions/sites/default/files/2021-05/information_note_msca_itn.pdf

Background

THREAD addresses the mechanical modelling, mathematical formulations and numerical methods for highly flexible slender structures like yarns, cables, hoses or ropes that are essential parts of high-performance engineering systems. The complex response of such structures in real operational conditions is far beyond the capabilities of current virtual prototyping tools. With 14 PhD positions at 12 universities and research institutions in Austria, Belgium, Croatia, France, Germany, Norway, Slovenia and Spain, the project brings mechanical engineers and mathematicians together around major challenges in industrial applications and open-source simulation software development. It establishes an

innovative modelling chain starting from detailed 3D modelling and experimental work to build validated 1D nonlinear rod models, which are then brought to a system-level simulation thanks to the outstanding numerical properties of the developed algorithms. This holistic approach combines advanced concepts in experimental and theoretical structural mechanics, non-smooth dynamics, computational geometry, discretisation methods and geometric numerical integration and will enable the next generation of virtual prototyping.

Research

The aim of this work is to develop a simulation code to study and understand the mechanical behavior of multi-filament cables and multi-wired harnesses on the mesoscopic level. The simulation should capture the frictional contact interactions between the filaments and wires in order to reproduce and predict experimental results. It should serve to identify constitutive laws for 1D macroscopic models.

The modelling of wire bundles will be based on a simulation code for flexible multibody systems developed at ULiège. The ESR will contribute to the development of this code for beam contact problems and will assess its ability to solve complex contact problems involving many highly flexible rods. The ESR will benefit from close interactions with ESR2 for the development of the modelling and simulation tool and with ESR11 and the team at ITWM for the experimental validation.

Secondments

During the project, the researcher will have the opportunity to participate in three secondments:

- a 3-months internship at the industrial partner GDTech in Liège (Belgium) supervised by Dr. Michael Bruyneel in order to receive training on simulation techniques in the industry and validate the software implementation;
- a 1-month internship at Central Supélec in Paris (France) supervised by Dr. Damien Durville to gain experience with an alternative simulation tool;
- a 1-month internship at the Fraunhofer Institute ITWM in Kaiserslautern (Germany) supervised by Dr. Joachim Linn for comparison between experimental tests and virtual experiments for equivalent constitutive laws.

The duration of these secondments can be adjusted according to the needs of the project and to the restrictions induced by the COVID-19 pandemic.

Requirements

- MSc in Computational Engineering, Computational Mechanics, Computational Physics, Computer Graphics, Applied Mathematics or related fields is preferred (all backgrounds are welcome to apply).
- Experience in numerical software development is highly desirable.
- Experience in modelling methods in mechanics and dynamics is desirable.
- High standard of spoken and written English.
- Qualification as an “Early Stage Researcher”, i.e. at the time of appointment no PhD and less than 4 years of research experience (full-time equivalent) after obtaining a degree that formally allows you to embark for a PhD.
- Mobility requirement: at the time of appointment an “Early Stage Researcher” must not have resided or carried out their main activity in Belgium for more than 12 months in the 3 years immediately prior to their appointment.
- For more details please see here: https://thread-etn.eu/

Multibody & Mechatronic Systems Laboratory
Department of Aerospace & Mechanical Engineering
www.ltas-mms.ulg.ac.be

Advisory and work environment

The researcher will be supervised by Prof. Olivier Brüls, who is an expert in flexible multibody dynamics, mechatronics, numerical simulation, control and optimisation methods. He/she will also benefit from close interactions with other PhD students and post-doc researchers of the group for the development of the modelling and simulation tool. During the project, the researcher will develop tight collaborations with Dr. Florence Bertails-Descoubes at INRIA in Grenoble (France) and Dr. Joachim Linn at Fraunhofer Institute ITWM in Kaiserslautern (Germany).

Applications

Please submit your application in English until **July 31, 2022** on the website https://thread-etn.eu. Applications must include a motivation letter, the curriculum vitae (in Europass format), the digital copy of the highest academic degree (e.g. master) and the recommendation letters or names of two scientific references. The recruitment procedure will guarantee a fair and equal treatment of all applications. Please contact Prof. Olivier Brüls by email (o.bruls@uliege.be) for any further information.

References

A. Bosten, A. Cosimo, J. Linn, and O. Brüls. A mortar formulation for frictionless line-to-line beam contact. *Multibody System Dynamics*, **54**: 31-52, 2022. https://doi.org/10.1007/s11044-021-09799-5