Modeling and simulation of cable transport systems

18 months post-doctoral fellow.
INRIA and STRMTG, Grenoble, France.
Starting date between November 2017 up to January 2018

Keywords: cable transport system, nonlinear dynamics, contact, friction, impacts, flexible multi-body systems, modeling and simulation, software development.

Context

The recent development of cable transport systems, especially in view of urban applications requires new research to better qualify their mechanical behaviors to improve their safety and performance. The study of the dynamics of cable in interaction with their supports (towers or pylons) by means of sheaves (pulley assemblies) is of utmost importance for the understanding of the global mechanical response of ropeways. Most of the practical study of such systems are generally based on strong assumptions: a) in a first approach, the dimensioning is made under static assumptions, neglecting the dynamics of the cable and b) the support are also considered to be perfect boundary conditions (clamped or bilateral frictionless prismatic joint). The goal of this long-term collaboration between STRMTG and INRIA is to improve the numerical simulation of cable transport systems into two directions. Firstly, the dynamics of the cable together with suspended moving pendulums that model the vehicles will taken into account. Secondly, a more accurate modeling of support including unilateral contact conditions, impacts and Coulomb's friction will be developed. The main objective is to model the dynamics of the cable (oscillations of the line and the vehicles) and to understand the influence of the passage of a vehicle over a tower, by modeling contact and friction in sheaves. The final goal is to develop a numerical model and software code by extending the ability of Siconos[1], in order to simulate cable transport systems with various levels of accuracy in the modeling.

Objectives

After a careful study of the literature, the objectives of the post-doc will be:

— to develop a numerical model of the dynamics a translating cable with moving suspended pendulums over two simple supports. In this step, the dynamics of terms of waves propagation (existence and stability) will be studied in details.

— to extend the previous step towards multiple supports that takes into account unilateral contact, impact and friction. The influence of the frictional contact boundary conditions will be studied in terms of tension in the rope and amplitude of the oscillations.

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[1]http://siconos.gforge.inria.fr General software for modeling and simulating nonsmooth dynamical systems

– to develop a model of sheaves with fixed pulleys and a moving cable with contact and friction and to study the passage of the grip of the vehicle into the sheaves. The effect of the nonsmooth behavior generated by the contact conditions over the dynamics of the cable will be detailed.

– to improve the model of sheaves by considering the rigid multi-body system that links the pulleys.

Skills The candidate must have a strong background in computational mechanics and nonlinear dynamics. Furthermore, the candidate must show some abilities to develop scientific computing code in a standard language (python, C, C++).

Environment

This post-doc will be supervised by Vincent Acary (INRIA) and M. Weiss (STRMTG).

Inria[2] is the French National Institute for computer science and applied mathematics that promotes "scientific excellence for technology transfer and society". The post-doc candidate will be welcome in the Bipop project team [3], a research team focused on the modeling and the simulation of nonsmooth dynamical systems.

STRMTG[4] is a national technical agency that is part of the French Environment, Energy and the Sea Ministry which is in charge of ropeway and guided transport safety.

Practical aspects

– Location: INRIA Centre de recherche Grenoble Rhône–Alpes.
Inovallée de Montbonnot, 655, Avenue de l'Europe, 38334 Saint Ismier Cedex.

– Duration : 18 months.

– Salary: around 2150 euros net per months.

Application

The applicant must send a CV and recommendation letters to

• Vincent Acary vincent.acary@inria.fr

• and Mathieu Weiss mathieu.weiss@developpement-durable.gouv.fr

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[2]http://www.inria.fr
[3]http://bipop.inrialpes.fr