Post-Doctoral position

Physically-based data-driven modeling for tire parameters estimation

Estimation de paramètres pneus via une approche d'identification boîte grise

Resulting from a research partnership between the Laboratory for Computer Science and Automatic Control (LIAS) and Michelin.

One Post-Doctoral position is available in the automotive area at Poitiers University, LIAS (https://www.lias-lab.fr/?lang=en), France.

Duration: one year including probation period. Extensions are subject to performance and funding.

Expected start date: January 2018 (spring 2018 at the latest).

SUPERVISION

Dr. Guillaume Mercère
Université de Poitiers
Laboratoire d'Informatique et d'Automatique pour les Systèmes
Bâtiment B25
2ème étage
2 rue Pierre Brousse
TSA 41105
86073 Poitiers cedex 9

Dr. Jérémy Vayssettes
Manufacture Française des Pneus Michelin – Centre de Technologies de Ladoux
23 Place des Carmes Dechaux
63000 Clermont-Ferrand
France

Contacts : guillaume.mercere@univ-poitiers.fr, jeremy.vayssettes@michelin.com

If you are interested, please send an email to Dr. G. Mercère (guillaume.mercere@univ-poitiers.fr) and Dr. J. Vayssettes (Jeremy.vayssettes@michelin.com) which includes:

(1) your curriculum vitae as well as a list of your publications,

(2) an application letter stating why the proposed research topic interests you,

(3) electronic copies of your MSc and PhD thesis.

SUMMARY

In automotive industry, the use of measurements recorded during so-called objective maneuvers (open loop maneuvers from driver actions point of view) and simulations tends to take a larger part in the tire certification process. Such requirements constrain tire manufacturers like Michelin to master vehicle dynamics and car manufacturer expectations at an increasingly fine level. The standard way to characterize the vehicle dynamics consists in using data-driven modeling or system identification, *i.e.*, using, *e.g.*, a sweep sine maneuver in order to identify some of the transfer functions between steering wheel angle and yaw rate or lateral acceleration. Several studies have been made during the last decade, leading to a good understanding of the role of chassis and tire characteristics upon the vehicle lateral dynamics. Moreover a specific test method has been developed by Michelin to provide both good levels of dynamics excitations and of tests repeatability.
Given the current knowledge and test methodology, this post-doctoral study aims at developing new identification algorithms to get access to both reliable vehicle transfer functions and accurate estimates of some tire parameters. Because a specific attention will be paid to relevant physically coefficient estimates, a gray-box model structure shall be used as well as identification methods suitable for the identification of structured state-space representations.

SUBJECT DESCRIPTION

The first objective of this study is to continue the work already done on this topic at Michelin, including:

- an overview of the vehicle + tire models in transient state (both at Michelin and outside), then an overview of the methods used by car and tire manufacturers to estimate tire parameters from on-track measurements,
- insights on the right level of tire + vehicle model assumptions to be made in order to guarantee model identifiability (number of degrees of freedom, cornering stiffness, lateral stiffness, …);
- an analysis of the impact of vehicle parameters (inertia, mass, induced steering, …) and of tire parameters (tread, belts, carcass rigidities) on the model representations,
- the definition of a test procedure allowing to get good levels of excitation and repeatability for a model identification purpose.

The second and main objective of this study will consist in developing, then implementing specific identification methods able to provide accurate tire parameters estimations from the data-sets yielded by Michelin. Because the aforementioned studies led to structured state-space descriptions with physical coefficients, the development of data-driven modeling techniques dedicated to gray-box state-space representations should be favored at a first attempt. Finally, investigating and discussing model assumptions in order to *(i)* improve the identification results, *(ii)* suggest a possible different path to get reliable physical parameter estimates will also be part of the work.
The candidate will be able to use both simulated (generated with accurate vehicle and tire simulators) and real data-sets. Generating additional tests and data-sets is conceivable in collaboration with Michelin experts and test drivers.

CANDIDATE PROFILE

Candidates must have a PhD or Doctorate degree (in systems and control, applied mathematics, electrical engineering, computer science or related fields) to apply for a fellowship. This Post-Doctoral proposal mainly requires skills in system theory, system identification and modeling of mechanical systems. Applicants should have a strong MATLAB programming experience. Knowledge in vehicle dynamics would be appreciated but is not mandatory. In addition to a very good level in mathematics and automatic control, proficiency in English is required.