PhD within the framework of the European project (ETN) “ECO DRIVE”:

Advanced cyclostationary signal-processing methods for combustion/mechanical breakdown

Context
This PhD position is part of the “ECO DRIVE” project, funded by the European Commission through the H2020 “Marie Skłodowska-Curie Innovative Training Networks” program (grant number 858018) and focusing on noise and vibration in eco-efficient powertrains of future vehicles. Different universities and companies in Europe are part of the project, which includes various training and exchange periods for all the PhD candidates involved.
The application context is the global design process for the next generation of electrified powertrains (including hybridized engines, electric motors, gearboxes, drivelines, etc.). The ongoing massive electrification of powertrains brings quite a large number of challenges in car industry, particularly in engineering and design concerning acoustic issues.

Scientific framework and global objectives
A major problem when analysing the noise emitted by IC engines is being able to break down the measured sound into the various contributions being emitted from the different sources, such as combustion, injection, knocking, turbocharger, bearings, etc. The traditional approaches are based on signal-processing tools that assume the availability of perfect references on the source of interest (SOIs) and rooted on the simplifying assumption of the stationarity of the signals. The objective of the PhD is to introduce advanced signal-processing techniques that push beyond these limits. Advanced microphone-array techniques will be used to separate the SOIs by jointly exploiting their spatial and statistical orthogonality. Recent latent-variable models will deal with the scenarios with noisy and possibly correlated references. A key point in achieving the separation will be to properly model the SOIs as angle-time cyclostationary processes in order to fully exploit their statistical specificities. The PhD will also address the separation of effects due to excitation, which are invariant in angle, and due to transfer paths, which are invariant in time. The approach will be based on an analysis of the measurements taken in nonstationary conditions and their benchmarking against simulations from models provided by other researchers. This will find applications in operational TPA.

Candidates must have completed an M2 level with excellent academic results in vibrations and acoustics / applied mathematics / mechanical engineering; they must meet the eligibility conditions of ETN projects (e.g. no residence in France longer than 1 year in the last 3 years).

Supervision:
Prof. Jérôme Antoni (LVA) and Prof. Didier Rémond (LAMCOS), University of Lyon,
The PhD will take place in France (Lyon), with 3 months exchange with KUL in Leuven, including a substantial salary and living allowance (supported by the EC grant allowed to the project).

Application is open from March to December, 2020; send a message to
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