http://lva.insa-lyon.fr/

The Laboratoire Vibrations Acoustique (INSA de Lyon) is looking for **a post-doc fellow in structural acoustics and vibration**

Keywords: mid-frequency vibrations, energy modeling, "trim" modeling, finite element model, Noise Vibration and Harshness (NVH), experimentations in mid-frequency domain, application on a lightweight truck cab.

The Laboratoire Vibrations Acoustique (LVA) is a research unit within an engineering school (Institut National des Sciences Appliquées de Lyon). It is focused on structural vibration, sound radiation, source identification and sound and vibration perception. **We are looking for a post-doc fellow (2 years) in structural acoustics and vibration for September 2013.**

Context

LVA is involved in the project CLIC "City Lightweight & Innovative Cab", funded by the "Fonds Unique Interministeriel" (FUI) and the "Fonds Européen de Développement Régional" (FEDER). This collaborative project of research and innovation brings together academicals research laboratories and industry partners:

- RenaultTrucks (truck manufacturer),
- ArcelorMittal (steel manufacturing corporation),
- ACOEM (vibro-acoustics engineering),
- A2MAC1 (automative benchmarking),
- Altran Technologies (high technology and innovation consultancy),
- FEMTO-ST laboratory (mechanics and structural dynamics),
- and LVA (vibro-acoustics).

The goal of the project is to develop an innovative and lightweight cab for urban and peri-urban trucks. This lightening is based on a use of "very high strength steel" pieces thinner than what is the case nowadays. The consequences on the vibro-acoustics of such thickness reductions may be prejudicial as long as it affects directly the acoustical isolation for example. Hence, a part of this project consists in developing new acoustics methods in order to quantify this degradation and to maintain the acoustical performances of the cab despites the lightening.
The LVA is responsible for a whole work package aimed at validating and synthesising the cab in the mid-frequency domain. This needs, in particular, to take into account the vehicle "trim" (dampers/absorbers/insulators…) in this frequency domain.

Description of the study

During the first phase of the CLIC project, we developed a vibro-acoustic prevision method in the mid-frequency domain including the influence of the trim through a PhD study started on December 2011. The method is based on an original prediction method mid-freq/high-freq developed at LVA and makes the link between a finite element model and an energy model (reformulation of the Statistical Energy Analysis) [1]. It allows determining the coupling loss factors between sub-systems and removes the assumption of equipartition of modal energies. The method has been developed and tested on a semi-complex case: rectangular plate partially

damped with an unconstrained viscoleastic layer coupled to a small acoustic cavity. Experimental/model comparisons have been carried out [2], and are going on for different types of structural trims (patches added on the plate).
In parallel to the development of the method, a numerical model (FEM) of the "reference" body in white cab has been developed by ACOEM, and updated using experimental data measured at LVA on the corresponding cab furnished by RenaultTrucks. This updating has been performed on the first modes of the cab structure (floor, front and rear side, doors) for the low frequency domain (up to 200Hz).

The purpose of this post-doctoral study proposed at LVA for the second phase of the CLIC project is to apply the vibro-acoustic prevision method on the whole numerical model of the reference cab, and to complete this model by adding the vehicle trim parts. The goal of the study is ultimately to optimise numerically the position/types of the trim in order to gain weight and without increasing the noise transfer.
The energy transfer between structure and cavity will be calculated numerically (Nastran/Actran) for the low-frequency range and estimated thanks to the improved SEA in the mid- and high-frequency domain. The trim will be added step by step on the numerical model, and results will be compared with experiments insofar as possible. Numerical investigations will be performed in order to go higher in frequency and to gain time; the study could be based on geometrical approximations for the estimation of the cavity modes for example.
The post-doc fellow will be involved in the mid-frequency group working on the project (four researchers, one research engineer and one PhD student). The fellow will be responsible for the numerical work and will participate to the design and realisation of the experiments on the cab.

The duration of the contract is 24 months, from September 1st 2013 (ideally). The salary will be 2200 euros/months (net of charge). The fellow will be granted in order to present his results to national and/or international congresses.
Candidates should have a PhD in mechanics/acoustics, with an experience in structural acoustics and vibration. A strong experience in numerical modelling is necessary (FEM software, Matlab…). The knowledge of the SEA is welcome.

Please email cover letter, CV, list of publications and contact information regarding academic or professional references to kerem.ege [at] insa-lyon.fr

Supervision

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References

[1] L. Maxit, J.-L. Guyader. Extension of SEA model to subsystems with non uniform modal energy distribution. *Journal of Sound and Vibration*, 265 (2), 2003, 337-358.
[2] H. D. Hwang, K. Ege, L. Maxit, N. Totaro, J.-L. Guyader. A methodology for including the effect of a damping treatment in the mid-frequency domain using SmEdA method. *Proceedings of 20th International Congress on Sound and Vibration (ICSV20)*, Bangkok, Thailand, 2013.

Projet CLIC

Projet de Cabine Innovante Allégée pour Camion de Distribution Urbain

CLIC "City Lightweight & Innovative Cab" est un projet collaboratif de recherche et d'innovation développé par CITI Technologies et ses partenaires :

- Renault Trucks,
- ArcelorMittal,
- 01dB-Metravib (ingénierie Vibro-acoustique),
- A2MAC1 (benchmark dans le secteur automobile),
- Le laboratoire Vibrations Acoustique de L'INSA de Lyon,
- Le laboratoire FEMTO (dynamique des structures et de la vibro-acoustique).

L'objectif du projet est de répondre aux problématiques des agglomérations et des contraintes de transport du futur. Le concept est une nouvelle cabine innovante et allégée destinée au transport urbain et périurbain.
Les axes d'améliorations traités par la cabine CLIC sont les suivants :

- L'optimisation de l'architecture de la cabine en intégrant de nombreux composants innovants visant à :
  - améliorer les aspects confort d'utilisation du conducteur pour diminuer la pénibilité
  - favoriser la maniabilité du véhicule
  - améliorer les aspects sécurité du chauffeur et des personnes en périphérie
  - permettre l'intégration des nouvelles motorisations hybrides et/ou électriques.
- L'allégement de la caisse en blanc de 20 à 25% grâce notamment à l'utilisation d'acier à très haute limite élastique (THLE). Cet allègement permettra une réduction des émissions de CO2.
- De nouvelles méthodes dans le domaine acoustique pour maintenir les performances de la cabine malgré son allègement.

Tous ces objectifs correspondent aux attentes et problématiques des pôles de compétitivité comme LUTB (Lyon Urban Trucks & Bus) qui a labellisé le projet en Mars 2011.