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***ECL_LTDS_Besset_01***

## PhD Proposal 2017

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| **School: Ecole Centrale de Lyon** | |
| **Laboratory: Laboratoire de tribologie et Dynamique des Systèmes** | **Web site: http://ltds.ec-lyon.fr/spip/** |
| **Team: Dynamique non-linéaire, incertitudes et systems avec interfaces** | **Head of the team: Prof. J-J. Sinou** |
| **Supervisor: Dr. Sébastien Besset**<br>**Dr. Frédéric Gillot** | **Email: sebastien.besset@ec-lyon.fr**<br>**http://d2s.ec-lyon.fr/perso/besset** |
| **Collaboration with other partner during this PhD:**<br>**In France:** | **In China:** |

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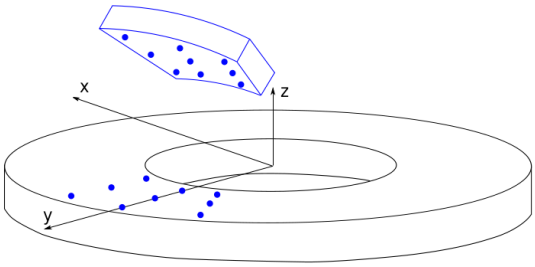
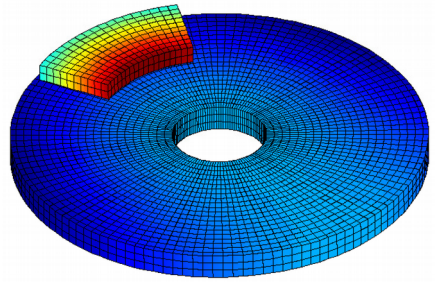
| **Title: Shape optimization of structures based on isogeometric formulations** |
| **Scientific field:** mechanical systems and structural dynamics. |
| **Key words:** structural dynamics; nonlinear vibrations; shape optimization; contact formulation, CAD, design, parametrization |

**Details for the subject:**

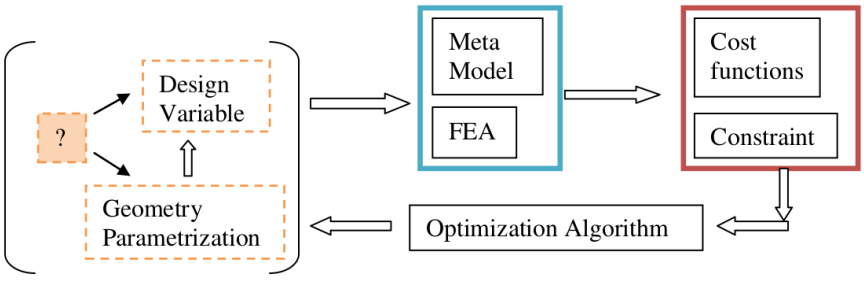
**Background, Context:**

Squeal noise for brake systems is an industrial challenge addressed by many researchers. Among the research topics on squeal noise, squeal prediction is the basis. The shape optimization of a brake system under noise criteria is a quite new subject. Indeed, squeal noise prediction needs costly calculations that are not easy to include in optimization algorithms. Moreover, the remeshing step remains hard since the contact between the two structures strongly depends on their shapes.



Currently, squeal noise issues are studied either through phenomenological models, or through finite element models. The first is interesting to study the squeal phenomena but does not allow to represent industrial structures. The second one allows to deal with big and complex structures, but are not very efficient in shape optimization context.




Isogeometric formulations allow to parametrize the structure in order to avoid the remeshing step in the optimization process. Nevertheless, this kind of elements are not easy to use in the context of friction interfaces, since the surfaces are not defined through physical points. Taking the contact between two structures into account needs other methods like Lagrange multipliers for example.

**Research subject, work plan:**

This Ph.D. work will focus on specific approaches for the parameterization of CAD geometries, enabling fast design optimization.

First, a simple CAD parameterization framework will be built in order to be able to deal with design optimization of components coming, for example, from car's parts. Such framework can be based on (Lindby and Santos) and (Othmer) basis.

Then, a "semi-industrial" brake structure will be considered. It will be made of two substructures, a pad and a disc. Isogeometric elements will be build and the contact between the two substructures will be implemented.

A last, a shape optimization strategy will be developed, that will allow a fast optimization process without remeshing step.

**References:**


[1] K. Soobbarayen, S. Besset, J.-J. Sinou, Noise and vibration for a self-excited mechanical system with friction, Appl. Acoust. 74 (10) (2013) 1191–1204.

[2] K. Soobbarayen, S. Besset, J.-J. Sinou, A simplified approach for the calculation of acoustic emission in the case of friction-induced noise and vibration, Mech. Syst. Signal Process. 50 (2015) 732–756.

[3] P. Du Cauzé de Nazelle, F. Gillot, L. Jézéquel, Mechanical product design based on shapes blending optimization under implicit parameters constraints. 9th World Congress on Structural and Multidisciplinary Optimization. Shizuoka, Japan (2011).

[4] T. Lindby, J.L.T. Santos. Shape optimization of three-dimensional shell structures with the shape parametrization of a CAD system. Structural and Multidisciplinary Optimization, 18 (1999), 126-133.

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