Date January 12th 2015
Contact Alejandro M. Aragón
Address Gebouw 34, Kamer G-1-380
Mekelweg 2, 2628 CD Delft
Telephone 015-278 2267
E-mail a.m.aragon@tudelft.nl

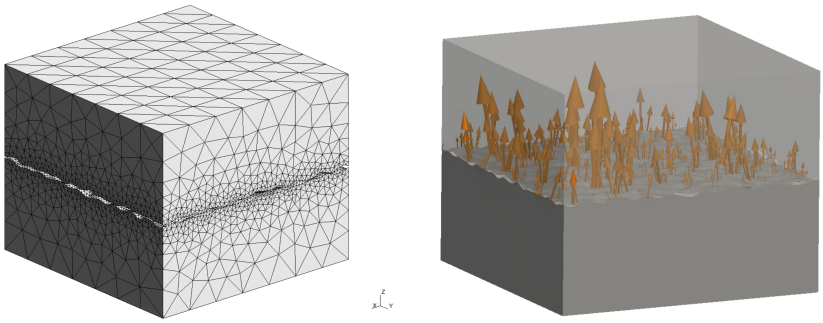
New finite element formulations for computational contact mechanics

Master of Science project

Abstract

The M.Sc. project aims at studying the feasibility of a new type of formulation for computational contact mechanics. Upon successful evaluation of the new formulation, the student will proceed to its implementation in *Hybrida*, a new finite element package being developed within the Structural Optimization and Mechanics (SOM) group.

Introduction Contact mechanics comprises a very active research field. The highly nonlinear nature of this phenomenon is the responsible for a great number of attempts with partial successes. Even though the computational contact mechanics research community seem to lean towards mortar type of formulations, these remain extremely difficult to implement. Other traditional approaches have a simpler implementation but in most situations they fail to reproduce a simple contact patch test. Figure 1 shows a simple contact model of two rough surfaces in contact, with the arrows in Figure 1b representing the pressure distribution due to contact. A frictionless Augmented-Lagrangian formulation was used at the backend to obtain these results. Due to the difficulty of the implementation of mortar-type methods, and the lack of robustness of traditional approaches, this project aims at searching the feasibility of new formulations that can be implemented within the finite element framework.



(a) (b)

Figure 1: Contact between two rough surfaces. a) Finite element mesh; b) Pressure distribution after contact.

Tasks *i)* Conduct a thorough literature review on the different methodologies that are used to study contact problems. In this way, the student will be familiar with the penalty method, Lagrangian and Augmented Lagrangian methods, the mortar method, among others. *ii)* The study of Generalized/eXtended FEM and their feasibility in the modeling of contact problems. *iii)* If feasible, the implementation of the new formulation within *Hybrida*, a new finite element library that is being developed within the Structural Optimization and Mechanics (SOM) group. *iv)* The modeling of contact patch tests to determine whether the new formulation is working as expected. *v)* The conceptualization of more challenging problems. *vi)* Presentation of results and the preparation of a report that could potentially lead to a peer-reviewed journal publication.

Requirements The student should have modeling experience and basic knowledge of finite element analysis. Knowledge of computational contact mechanics is a plus, and programming experience with the Python language is recommended.