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COMPUTATIONAL STRATEGY FOR TAKING GEOMETRICAL UNCERTAINTIES INTO ACCOUNT IN STRUCTURAL ASSEMBLIES

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ABSTRACT

Geometrical uncertainties are of a great importance in the behaviour of assemblies of structures. Bolted joints in wide structures must include gaps to insure the capability of the connection to be assembled, but the load capacity of the connection can be extremely dependent of those gaps. Moreover, in such wide assemblies, positions of the bolts, orientation and shape of the holes, quality of the surfaces, ... can be extremely uncertain.

In the last decades, the LATIN method, proposed by Pierre Ladevèze [1], have been extented to the study of assemblies of structures. Using a domain decomposition approach, such assemblies are considered as a group of substructures linked by interfaces. Interfaces are the key elements of the approach. They are mechanical entities representing the behaviour of the connections of the assembly: perfect connections, contact, friction, gaps, ... The resolution process is a local-global iterative process issued from the LATIN method. This approach have been applied with great success to large scale assemblies for aeronautical applications [2].

It has recently been extended to the study of connection uncertainties in assemblies (gaps, friction coefficients, ...). Using the capabilities of the local-global iterative process to re-use a previous solution for the initialisation of a new computation and thus to reduce the number of needed iterations, a multiresolution strategy is set up [3]. The strategy allows a great reduction of the computational costs when a large number of computations have to be carried within the framework of a statistical study of the influence of connection parameters.

In the present work, the geometrical uncertainties are represented by a varying gap distribution on the surfaces of the contact interfaces. The multiresolution strategy is coupled with the Openturns environment [4]. This open source python environment allows the statistical description of the parameters and provides a wide range of resolution methods (Monte Carlo, LHS, response surfaces, ...). During the execution of one of those methods, the Openturns program ask for the concurrent computations of the response of the assembly for different sets of the parameters. They are concurrently carried out by the multiresolution program running in server mode on different nodes of a cluster.

The proposed applications concerns aeronautical bolted joints including different types of geometrical uncertainties. The capabilities of the Openturns/Multiresolution strategy coupling are presented.

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