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CALL FOR ABSTRACTS

Special session on
Flexible Tolerancing Analysis of Complex Structures and Assemblies

Description

In industry, the modelling of product / process assemblies is based on the theory of Geometrical Product Specification – GPS – and Tolerancing Analysis. This industrial approach follows several international ISO GPS standards to specify the parts and build stack-ups models of tolerances of an assembly. The main hypothesis of these standards is the rigid workpiece principle.

However, in many cases, for large dimensions thin parts and their assemblies as example, the effects of gravity and of the forces and/or displacements imposed by active tools or other internal forces coming from potentially desired over constraints (hyperstatism), this rigid bodies assumption is not is not relevant : some deformations due to existing forces are higher than parts tolerances. Thus, “classic rigid stack-ups” can lead to non-representative results on functional requirements.

Sometime resulting geometry of assemblies can be good, but the problem comes from installed constraints potentially harmful for the reliability (undesired crack during assembly, reduced performance in fatigue…). Sometime, the geometry of a sub assembly seems to be not conform, from GPS conformity point of view, but with no consequence for the assembly at upper level, taking advantage of elasticity.

In all of these cases, flexibility is a key factor, helping or disturbing the result, and the key criteria to analyze are often not in mm, but potentially in Newton or N/mm²…

Thus, to take into account the flexibility of the parts and assemblies in the 3D tolerancing stack-ups, some recent academic and industrial works have proposed several methods, coupling the tolerancing theory, the uncertainties propagation methods and FEM simulations.

For example, some scientific challenges are:

- Geometrical, stochastic and meshing modelling of geometrical characteristics,
- Uncertainties propagation in assembly FEM models,
- Massive stochastic dimensions of stack-ups models.

So flexible tolerancing analysis is close enough structural reliability analysis and some methods are common between the two disciplines.

Motivation

Participants to this special session will gain knowledge about the innovations in the tolerancing domain and the lessons learnt about the practical use of existing tolerancing frameworks.

Flexible tolerancing analysis was introduced in the late 2000 to handle the geometry and safety analysis of complex assemblies and to ensure their compliance with the geometrical product / process functional requirements, with non-rigids parts. This transverse discipline is promised also to ease the dialogue between CAD specialists, tolerancing specialists and FEA specialists as well as the active sharing of the hybrid models building, validation and application.

Flexible tolerancing is currently applied with different maturity levels in industries. Articles on industrial application could be presented to argue the benefits and limits of these approaches.

Objective

Contributions on the following topics are welcome:

- Geometrical, stochastic and meshing modelling of geometrical characteristics of parts,
- Stochastic process modelling and simulation,
- Uncertainties propagation in assembly FEM models for tolerancing analysis,
- Massive stochastic dimensions of stack-ups models,
- Tolerancing results and analysis and direct impact on structural reliability and safety analysis,
- Illustration of industrial cases where elasticity and internal forces and stress becomes key factors in product performances and variability.

Organizer

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