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Interactive Simulation of Flexible Surface-like Parts as a Digital Support Function for Assembly Planning in the Automotive Pre-series Centre

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1. Introduction on the industrial use case

In automotive development there is a growing demand for tools that enable the simulation of flexible surface-like components. In comparison to conventional software tools IPS already offers a fast simulation for specific flexible shell structures, like bellows and grommets or flexible flat cables [1]. For trim parts, interior and exterior panels there are currently no commercial software solutions that can support simulations in real time.

In a joint development project with a German OEM from automotive industry (Audi AG) a practically useful approach has been developed that provides an enormous computational speedup for flexible surfaces, enabling frame rates in the range of 50 – 90 Hz, which is sufficiently fast for interactive simulations in the IPS desktop. In our presentation some typical application examples like the one in *Fig. 1* below are shown. We expect that in the future this improved simulation technology will enable assembly simulations of flexible surface-like parts in virtual or extended reality (XR) environments.

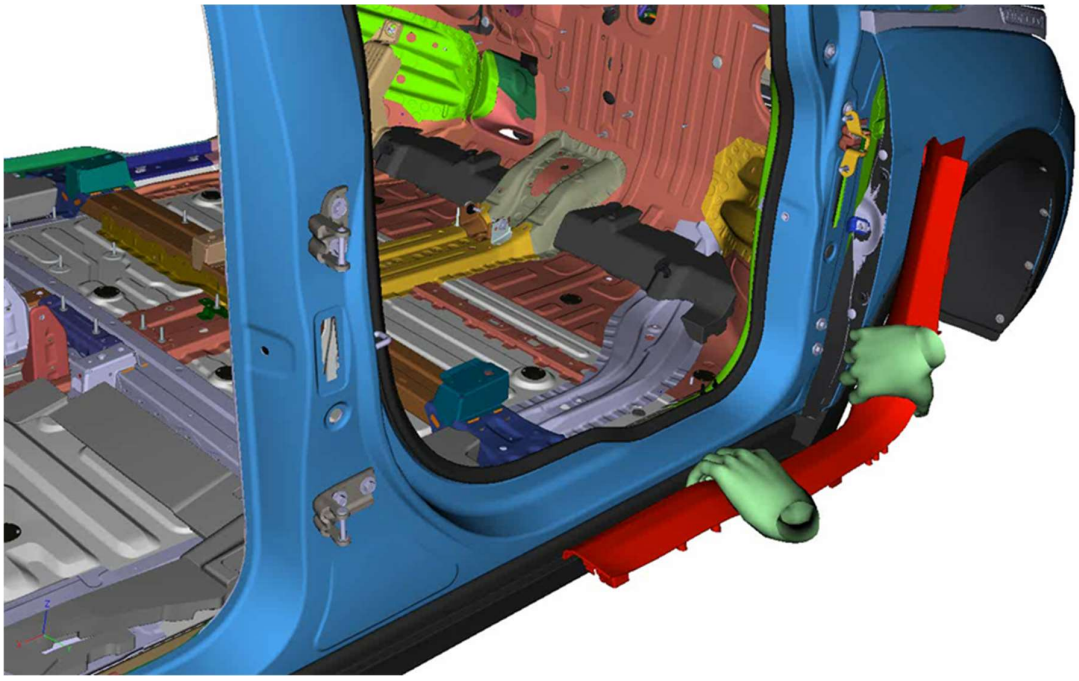

Figure 1. Screenshot taken from a “live” movie that shows an interactive assembly simulation of a flexible trim panel. During assembly the flexible part is grabbed by two hands and substantially deformed for fitting in its final position.

2. Methodical background and industrial application aspects

We will provide some background on the computational methods used for a speed-up of the full computational model [2] closely related to geometrically exact Cosserat shells [3], including an extended usage of a linearized shell model derived via static condensation (a.k.a. Guyan reduction, see Ch. 8 in [4]) for moderately large deformations in the "grey zone" between the geometrically linear and nonlinear domains.

For the industrial application it is important how such a simulation tool fits within the industrial workflow, considering the procedure to set up the model within the software framework, as well as the efforts spent and the type of information that an industrial user has to provide before being able to use the simulation tool. We will also outline such industrial application aspects which besides computational performance are very important for the user acceptance of such a digital support function.

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References

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