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INTEGRATION OF FLANGE CONNECTIONS IN THE GRAPH AND HEURISTIC BASED TOPOLOGY OPTIMIZATION OF CRASHWORTHINESS STRUCTURES

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Abstract: In the simulation of crashworthiness structures different kinds of nonlinearities like large deformations, contact and material nonlinearities appear. In order to optimize the topology of such structures, Olschinka, Ortmann and Schumacher [1,2] introduced the Graph and Heuristic Based Topology Optimization (GHT), which deals with the optimization of crashworthiness profile structures. For changing the topology, heuristics derived from expert knowledge are used. The basic approach of the GHT is limited to profile structures, as the graph syntax, which describes the profile cross-section and the heuristics, that modify the topology, were developed only for the extrusion manufacturing process. Due to the demand for using different manufacturing processes, the approach is extended to sheet metal compound structures. In the extension described in this contribution, the structure is split into multiple less complex parts, which can be independently manufactured and later bonded to the complete structure. Because flanges and bonding have a huge influence on the mechanical behavior, the flanges and the bonding have to be included in the analysis model of the optimization. Therefore, new modeling schemes are used to define the number and positions of the flanges. In general all kind of bonding techniques can be used. In the first extension, the approach is limited to adhesive bonding. Depending on the bonding technique, it is necessary to create flange connections to increase the joining surface area and thus the strength of the bonding. The new optimization procedure is illustrated with the help of an example. The optimization results for different manufacturing processes of the component are compared. The example consists of an automotive rocker (material: steel) and a cross member in a side impact crash load case and different static load cases.

References

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