A new strategy for stiffness evaluation of sheet metal parts

Abstract:
In the automotive industry, surfaces of styling models are shaped very often in physical models. For example, in the styling process of a car body important design work is realized by clay models and the resulting geometry information typically comes from optical scans. The scanned data is given in the form of point clouds which is then utilized in the virtual planning process for engineering work, e.g. to evaluate the load-carrying capacity. This is an important measure for the stiffness of the car body panels. In this contribution, the following two issues are discussed: what is the suitable geometric representation of the stiffness of the car body and how it is computed if only discrete point clouds exist. In the first part, the suitable geometric representation is identified by constructing continuous CAD models with different geometric parameters, e.g. Gaussian curvature and mean curvature. The stiffness of models is then computed in LS-DYNA and the influence of different geometric parameters is presented based on the simulation result. In the second part, the point clouds from scanned data, rather than continuous CAD models, are directly utilized to estimate the Gaussian curvature, which is normally derived from continuous surfaces. The discrete Gauss-Bonnet algorithm is applied to estimate the Gaussian curvature of the point clouds and the sensitivity of the algorithm with respect to the mesh quality is analyzed. In this way, the stiffness evaluation process in an early stage can be accelerated since the transformation from discrete data to continuous CAD data is labor-intensive. The discrete Gauss-Bonnet algorithm is finally applied to a sheet metal model of the BMW 3 series.

Stichworte:
Stiffness evaluation, Gaussian curvature, point clouds, Gauss-Bonnet theorem
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