HIOMESH

Higher order Mesh Generation for Industrial Geometries

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Projektbeschreibung

An accurate volumetric decomposition of geometry would be instrumental in solving an entire class of problems in mesh generation and numerical simulation. It would undoubtedly pave the way to fully automated hexahedral and higher order mesh generation algorithms. Since the major bottleneck in hexahedral and other higher order mesh generation is the volumetric decomposition, a flexible volumetric decomposition algorithm would provide somewhere between a 90% time reduction in mesh generation to full automation.
A robust algorithm which provides medial axis (in 2D) and a medial surface in 3D would solve this problem. It has not always been easy to compute accurate medial surfaces in 3D geometries. Geometric methods such as Voronoi diagram do not work on all geometries and do not always guarantee a solution. They are also quite complex, slow and have much overhead. There have been many voxel-based methods which have proven to be right in approximating a medial surface for many geometries despite their approximation nature. The research work would concentrate on the development of a robust medial surface algorithm and extend its capabilities to build a robust grid generation tool. The research work would specifically focus on PDE based medial surface extraction algorithms.
Different non-algorithmic grid generation approaches would be implemented on top of this algorithm to achieve near complete automation. There are vital areas in fluid mechanics and gas dynamics which demand high-quality meshes with precise orthogonality, boundary layer clustering and so on. Most of the particle methods fail to resolve the physics in these class of problems due to a poor approximation of the geometry. They also prove to be costly due to the need for a vast number of particles. However, the rigidness of existing grid generation packages and lack of good automated grid generation algorithms has been the major drawback for this community. Hence they rely on voxelization for obtaining a volumetric approximation.
This research would readily pave the way for these problems which demand highly accurate volumetric decomposition. It would also focus on development of a more generic grid generator for industrial applications. The creases and sharp features are captured in the volumetric domain with the help of higher order non-linear elements. This would not limit itself to hexahedral elements. A wide variety of higher order elements would be supported in this general purpose grid generator. It would strive for as little manual work as possible. As a result of this project, higher order accurate numerical methods such as DG-FVM and NEFEM could be adapted for industrial purposes and can be used to solve a number of continuum scale

problems in the industry.

Projektpartner

- ESS Engineering Software Steyr GmbH