NEW DEVELOPMENTS IN IMAGE-BASED MESH GENERATION OF 3D IMAGING DATA

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SUMMARY

There has been increasing interest in the generation of computational models from 3D imaging modalities such as CT, micro/nanoCT, MRI, and Microscopy. The paper will focus on techniques specific to image-based mesh generation, and will also discuss new tools improving the interface with CAD, FEA and CFD. A number of examples that cover different applications within Computational Mechanics applications (e.g. soils, materials, 'as built' parts, and human anatomy) will be presented.

Methods

The mesh generation technique presented by the authors works directly on the image data, exhibiting sub-voxel accuracy and taking into account partial volume effects. The technique is also topology and volume preserving, avoiding loss or gain of volume. In addition, multipart meshes consist of matching nodes and elements which eliminate the need for contact constraints.

A proprietary technique has been developed which allows the setting of different density zones throughout the model. This allows the overall number of elements required to capture a given geometry to be reduced while allowing an increase in the mesh density around areas of greater interest.

Micro-architectures can be generated to conform to an existing domain. Control of the domain's mechanical properties is achieved using a re-iso-surfacing technique allowing density variations throughout the architecture and micro-architectures with specific porosities to be generated.

The concept of a relative density map to represent the desired relative densities in the micro-architecture where the minimum and maximum porosity values can be specified is introduced.

A new homogenisation algorithm allows computing orthotropic mechanical properties from higher resolution scans. This enhances the value of the information obtained at micro level, enabling it to be used for macro models on desktop computers.

Conclusion

The ability to automatically convert any 3D image dataset into high quality meshes is becoming the new modus operandi for computational analysis. New tools for image-based modelling have been demonstrated, improving the ease of generating meshes for computational mechanics and opening up new areas of research.