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Integrating Numerical Simulation and Geometric Design<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/>sign<br/





## Integrating Numerical Simulation and Geometric Design<br/> Statement Stresson Stress

### **Results in Brief**

# Product development and design becomes easier

Advanced software capabilities have helped enhance design and innovation in product development, particularly in the medical and engineering fields.



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Product development, which is often tied to innovation emerging from small and mediumsized enterprises, represents a key part of the European economy. Bridging the design phase with the analysis phase is important for furthering product development and can readily be achieved with isogeometric analysis.

With this in mind, the EU-funded INSIST

geometric design technology) project developed new software to advance integration between the two phases of product development. Bringing together key stakeholders from industry, engineering, mathematics, applied geometry, computer science and academia, the project team addressed limitations with current computer-aided design (CAD) software.

One area where this technology showed considerable promise is in the medical field.

To illustrate, the team worked on discretising and simplifying models for medical equipment. It developed enhanced software for surface models and geometric representations of computed tomography-scan–based objects for medical applications.

In parallel, the project team then worked on 3D isogeometric analysis formulation based on CAD shape functions. In addition to work on hybrid methods that exploit isogeometric analysis, it also developed sophisticated meshing software for surface models that can be coupled to existing finite element mesh generators.

Noteworthy as well is the development of methods that take advantage of voxelbased geometry data in the context of numerical analysis. Advances in this area can help overcome previously unsolved problems using advanced computer capabilities. The Voxel processing improvements have led to improved parametrisation and visualisation software, better modelling capabilities from medical images, and new algorithms for recovering sharp features from image-data.

In terms of dissemination, the project team published several journal papers and international conference papers, in addition to organising global workshops. It developed in-house computer programmes, one of which is an open-source software available to the public online.

The project's software outcomes are set to facilitate the analysis, simulation and design of engineering products. This will diminish computational costs and facilitate the development of real-world applications. Engineering and medicine are two fields that could particularly benefit from this new technology.

### Keywords

Isogeometric analysis, numerical simulation, INSIST, computer-aided design, meshing software, voxel

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**Project Information** 

INSIST

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