our future through science

Multi-physics fluid-structure interaction modelling software

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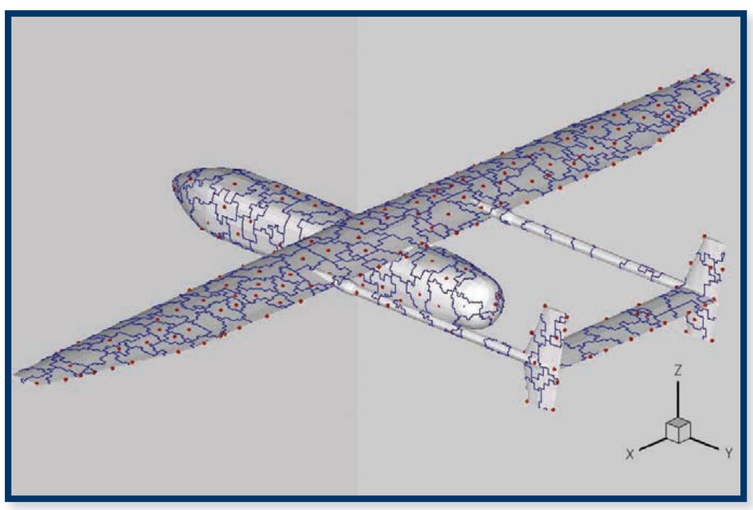
Internationally leading aerospace company Airbus sponsored key components of the development of the CSIR fluid-structure interaction (FSI) software. Below are extracts from their evaluation of the developed technology:

- "The field of FSI covers a massive range of engineering problems, each with their own multi-parameter, individual challenges. The progress you and the CSIR team have made over the past few months has laid solid foundations for the continued development of the new method against the needs of major aerospace companies such as Airbus."
- "We have found the demonstrated approach both scientifically innovative and potentially of great practical application."
- "We look forward to furthering the FSI work through future collaborative research, between Airbus and the CSIR."

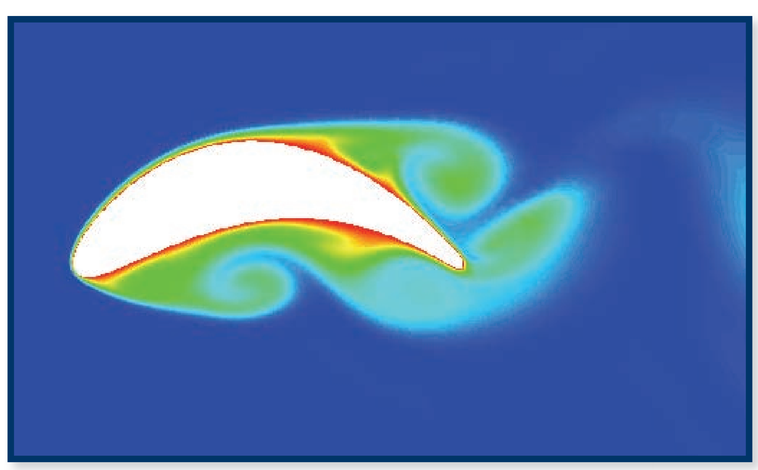
IN-HOUSE CODE CAPABILITIES

- Generic flow physics: Sub, trans- and supersonic flow
- Generic solid modelling: Heat conduction and stress analysis
- Free surface modelling capabilities
- Coupled fluid-solid interaction
- Generic computational mesh applicability (all elements)
- Advanced fast and efficient edge-based discretisation
- Fast and efficient matrix-free solvers: Multigrid & GMRES
- Novel parallelisation.



TRACK RECORD AND CURRENT PROJECTS

- Denel and Air Force: Efficient multigrid solver
- CHPC: High performance solver for super computers
- Airbus: Novel fluid-structure-interaction code
- Airbus: Free-surface modelling for fuel sloshing analysis.



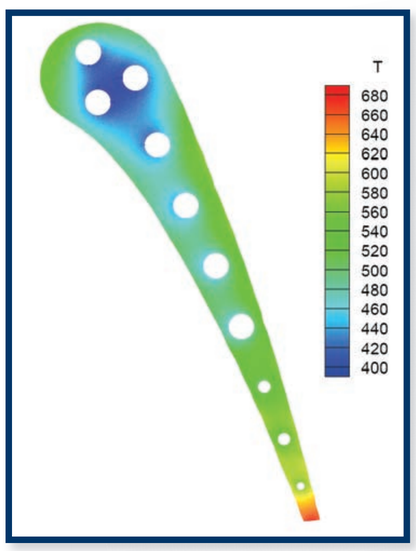
RESEARCH AREAS

- Next-generation commercial aircraft analysis and design
- Efficient and accurate aeroelastic modelling
- Novel, fast and efficient solver algorithms
- Use of super-computers in aerospace analysis and design.

FLUID-STRUCTURE INTERACTION (FSI): CURRENT STATE-OF-THE-ART

- Commercial codes severely limited: 'Partitioned approach'
- Long analysis times required to achieve strongly-coupled converged result
- Resulting trade-off is inaccuracy
- Unified codes are research codes with poor industrial applicability
- Enforce the same solution methods in fluid and structure domains – leads to numerical difficulties.

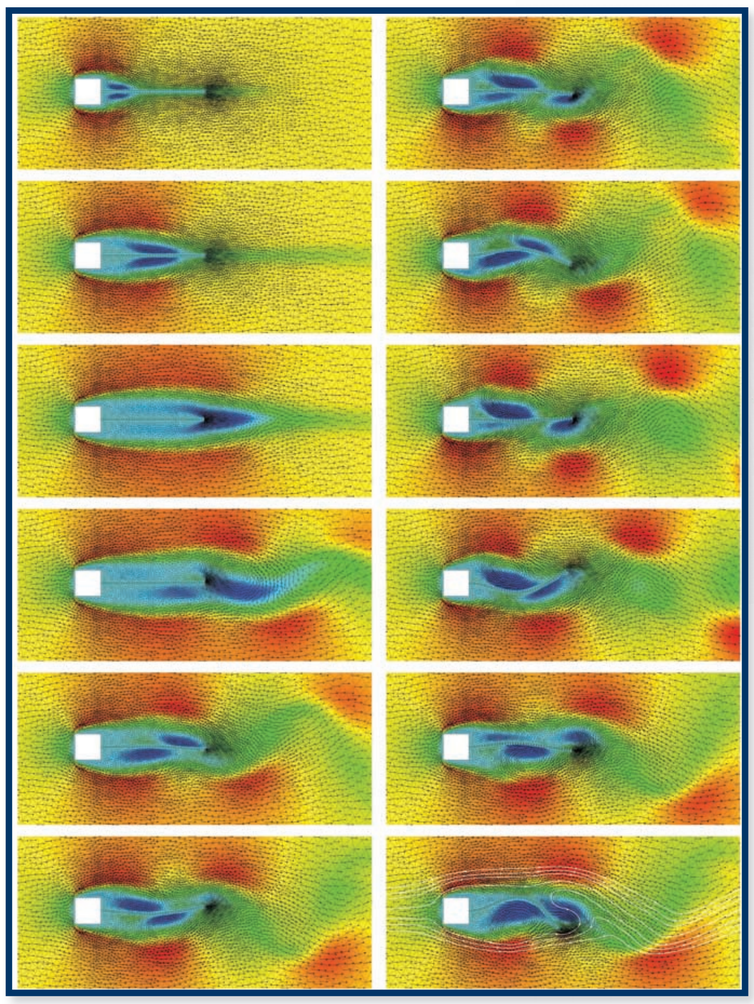
CSIR UNIFIED FSI CODE



- New stable and robust flow solver
- Novel mathematics: Formulation of equations for moving grids (Arbitrary Lagrangian/Eulerian)
- Dynamic mesh movement algorithm ensuring optimal element quality
- Stress analysis: New accurate finite volume solver, fully catering for large structural deformations and geometrical non-linearities
- Full coupling at solver sub-iteration level ensures a stable, fully-converged solution
- Solver supports hybrid (mixed structured/unstructured) grids
- Full coupling without enforcing a unique discretisation or solution method
- First truly scalable edge-based solver to implement the above technologies.

RIGOROUS VALIDATION

- Fluid flow: Benchmarked all flow regimes (diffusion-dominated to convection-dominated)
- Performance demonstrably superior to previous methods
- Solid modelling: Validated against international benchmark problems
- New element-based strain and structured meshes found to give vastly superior accuracy
- FSI: Excellent agreement with latest work of others.



CSIR researchers develop new ground-breaking software modelling technologies to be used in the design of safe and efficient next-generation aircraft.