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MIP: Engineering-2020
Modernization, Innovations, Progress:
Advanced Technologies in Material Science,
Mechanical and Automation Engineering

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«MIP: Engineering-2020: Modernization, Innovations, Progress: Advanced Technologies in Material Science, Mechanical and Automation Engineering»

«Complex geometry threedimensional curvilinear grids construction for numerical flow calculations»

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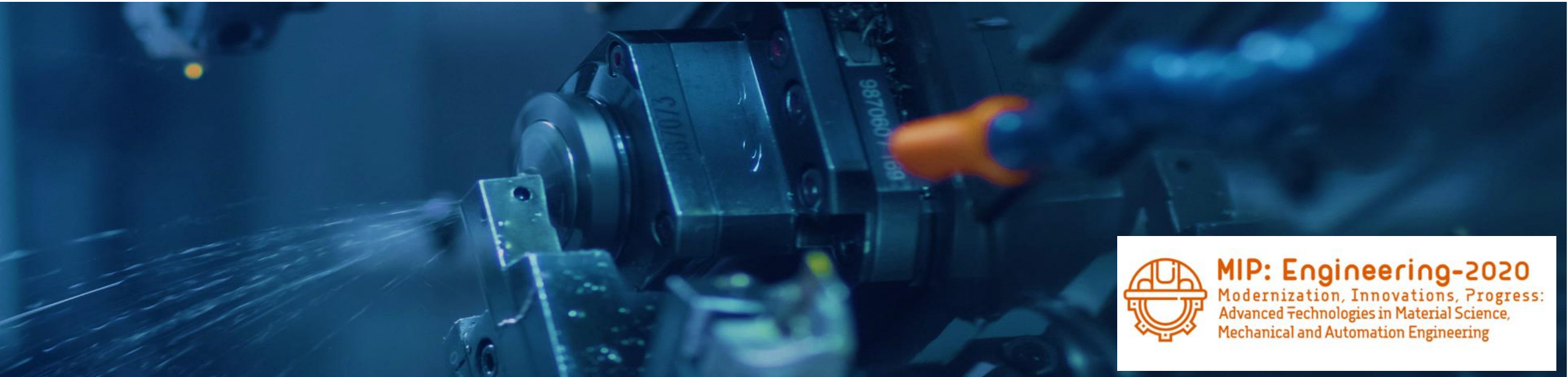
Problem statement

- Numerical solution for fluid dynamics applicable to complex surface geometries require special finite-difference grids
- Orthogonal grids make solving algorithms difficult and disallow cell size reducing near surfaces
- Task: three-dimensional curvilinear grid generation



Solution methods

First method: use two-dimensional curvilinear grid generation based on solving Laplace equation (conformal map) and combine all 2D grids to 3D grid.

Approach is good for axially symmetric surfaces. Not always possible combine 2D grids for axially unsymmetric surfaces.

Solution methods

Second method: fully three-dimensional curvilinear grid generation

Algorithm: similar to conformal map from orthogonal to curvilinear grid. First, initially fill grid (fig. 1). Second, numerically solve Beltrami operator. Final grid will be close to orthogonal. Maximal nonorthogonality measure value is $5.1 \cdot 10^{-2}$. Visual results shown at fig. 1 and fig. 2

Solution methods

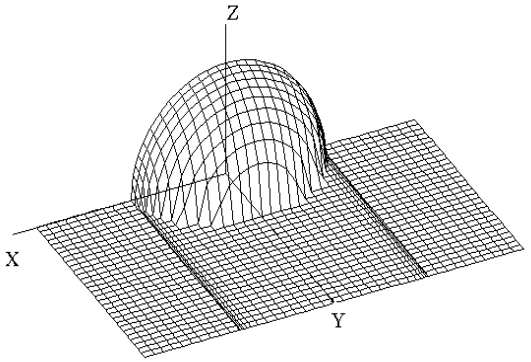


Figure 1. Initial grid

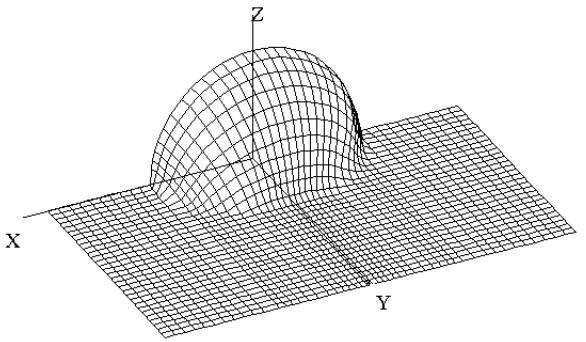


Figure 2. Optimized grid

Conclusions

Results, implementation

Described method allow to generate three-dimensional finite-difference curvilinear grids closely to orthogonal grids

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