

CFD Simulations in the Secondary Air System with TRACE - Use Cases and Requirements

TRACE User Conference

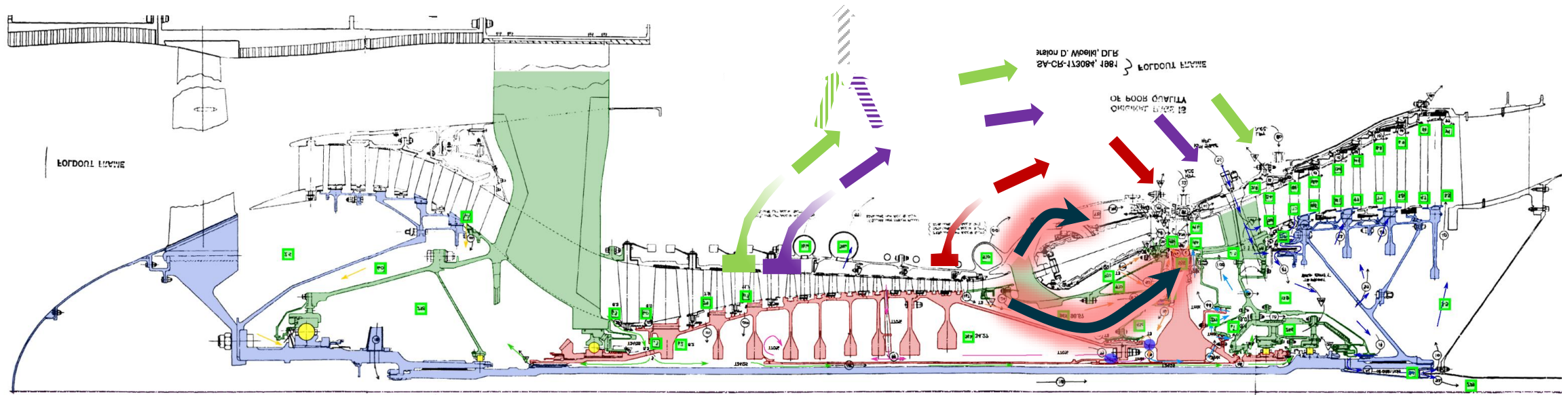
27.11.2025

Sadiya Tabassum, Laura Gante

DLR-Institut für Test und Simulation für Gasturbinen

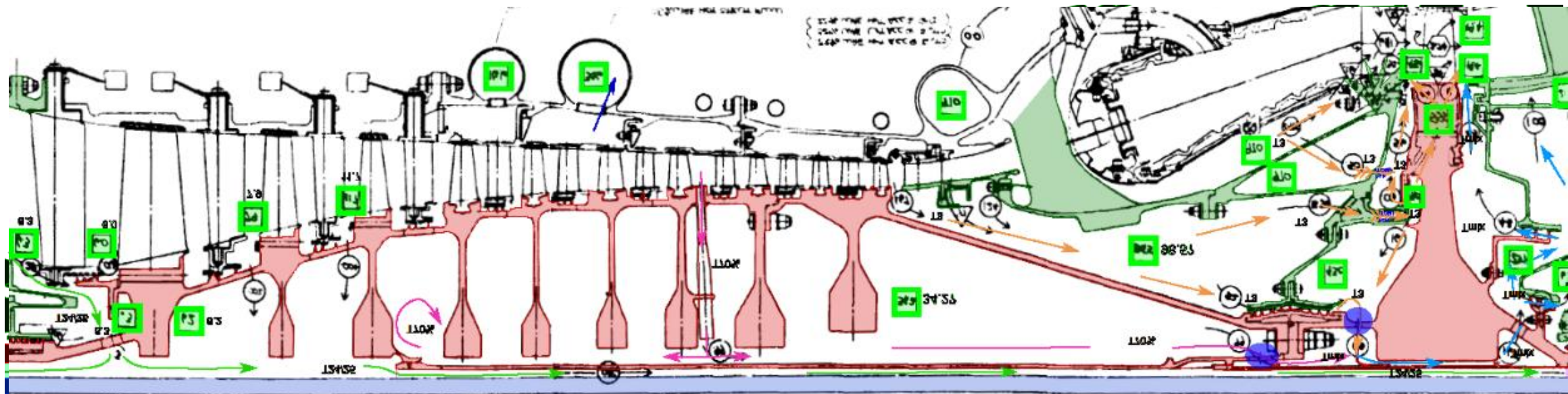


Secondary Air System



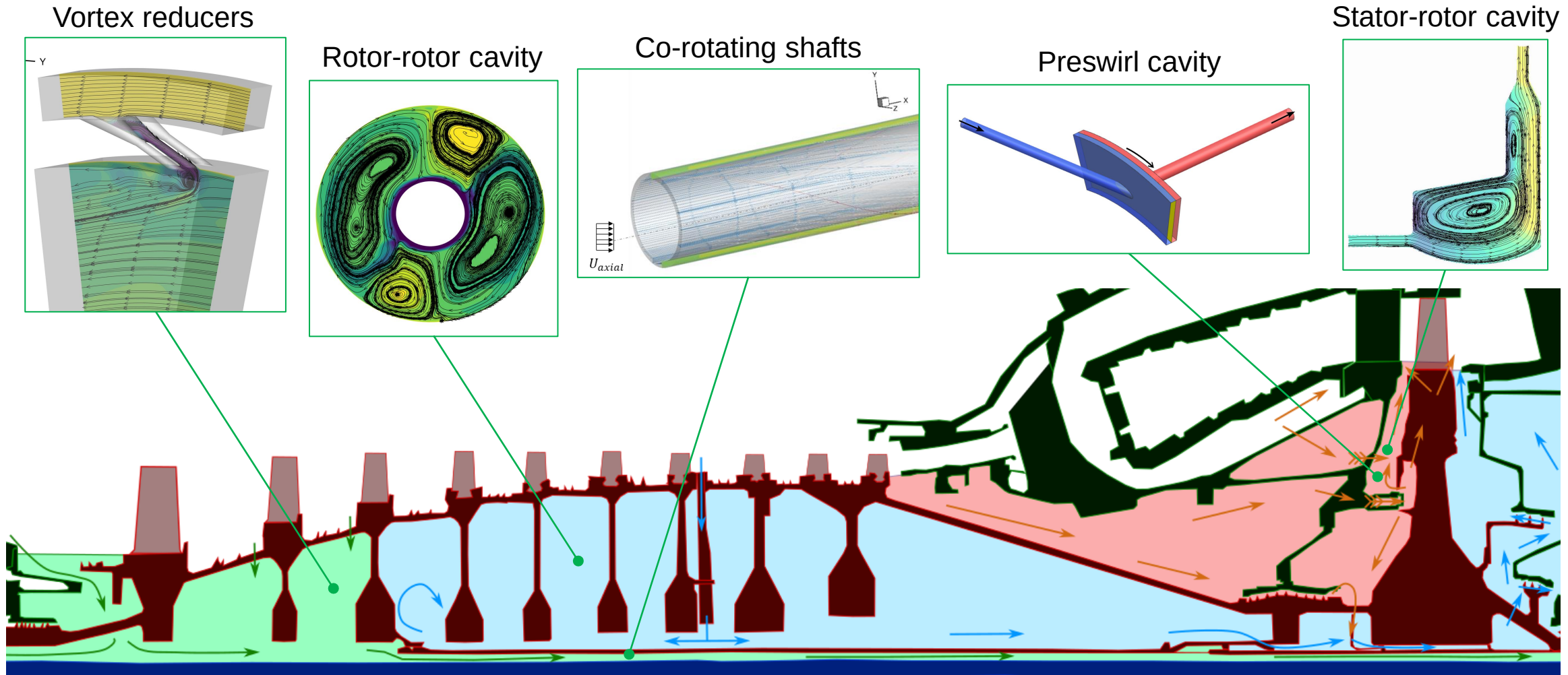
based on NASA-CR-173084, 1981

Secondary Air System



based on NASA-CR-173084, 1981

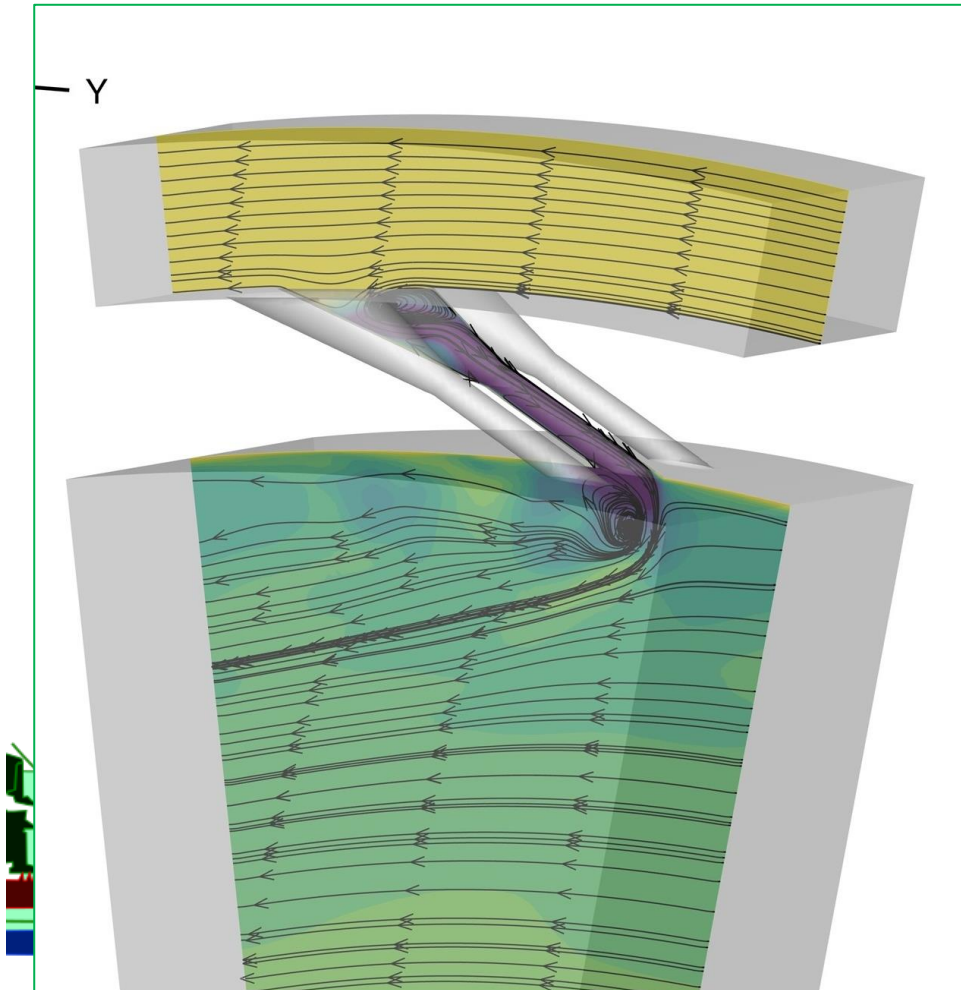
Use Cases in Secondary Air System



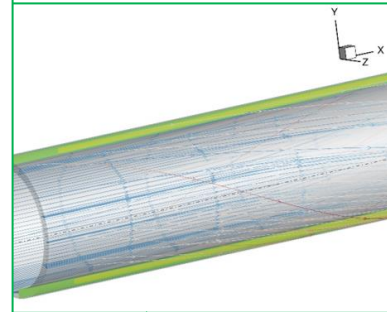
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Use Cases in Secondary Air System

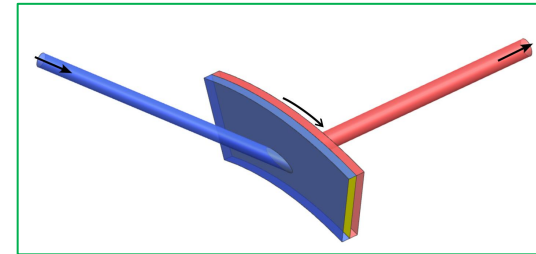
Vortex reducers



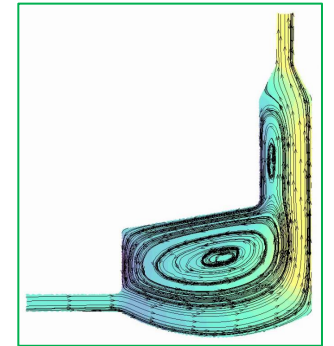
Co-rotating shafts



Preswirl cavity

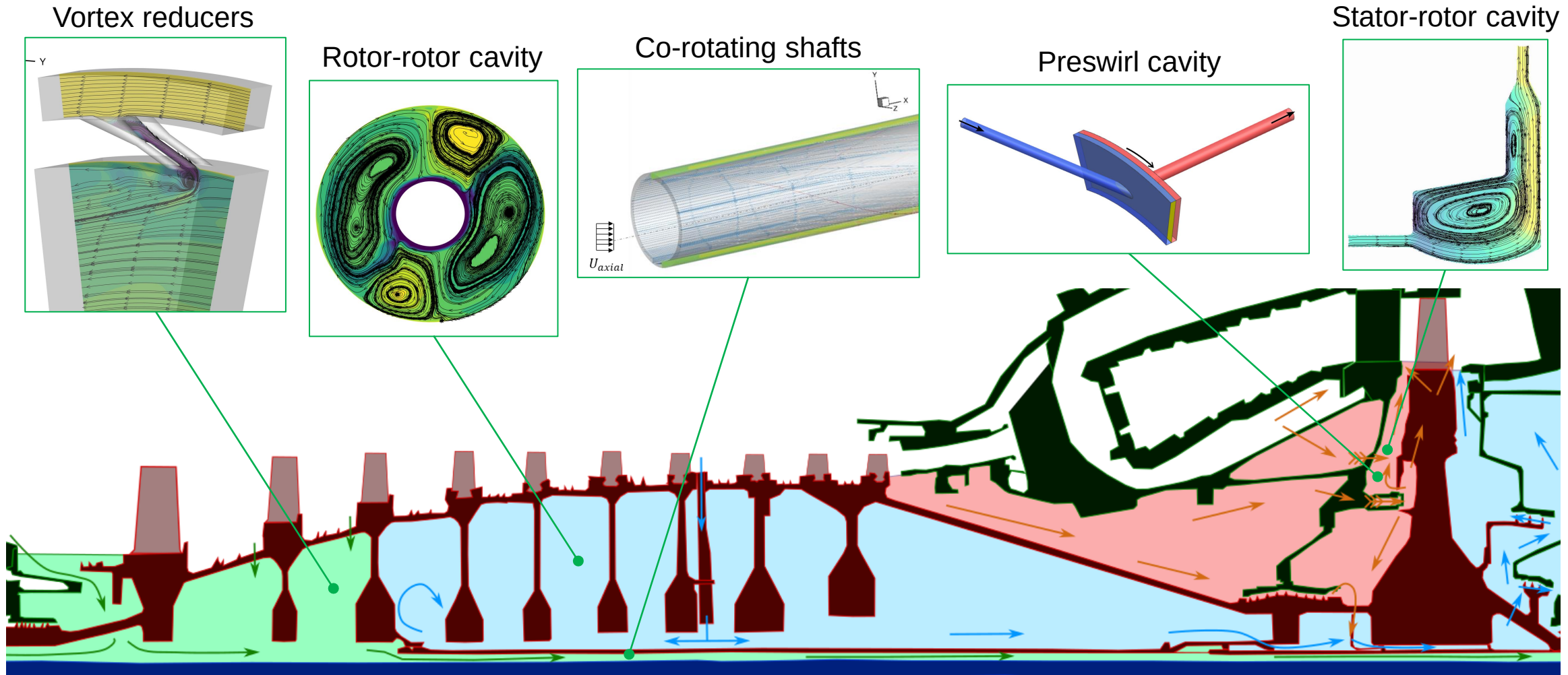


Stator-rotor cavity



based on NASA-CR-173084, 1981

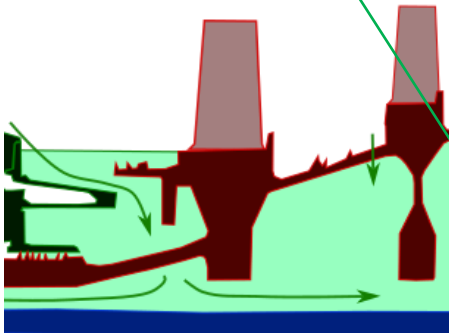
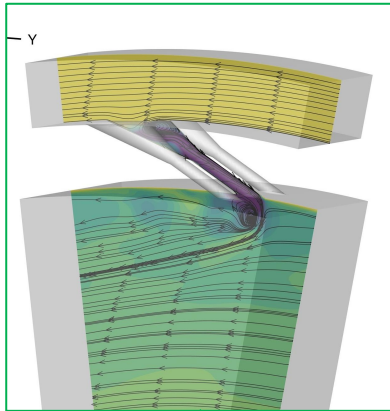
Use Cases in Secondary Air System



based on NASA-CR-173084, 1981

Use Cases in Secondary Air System

Vortex reducers



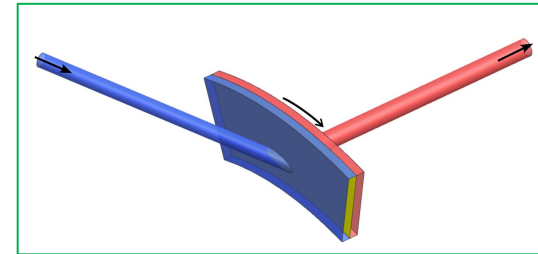
Rotor-rotor cavity



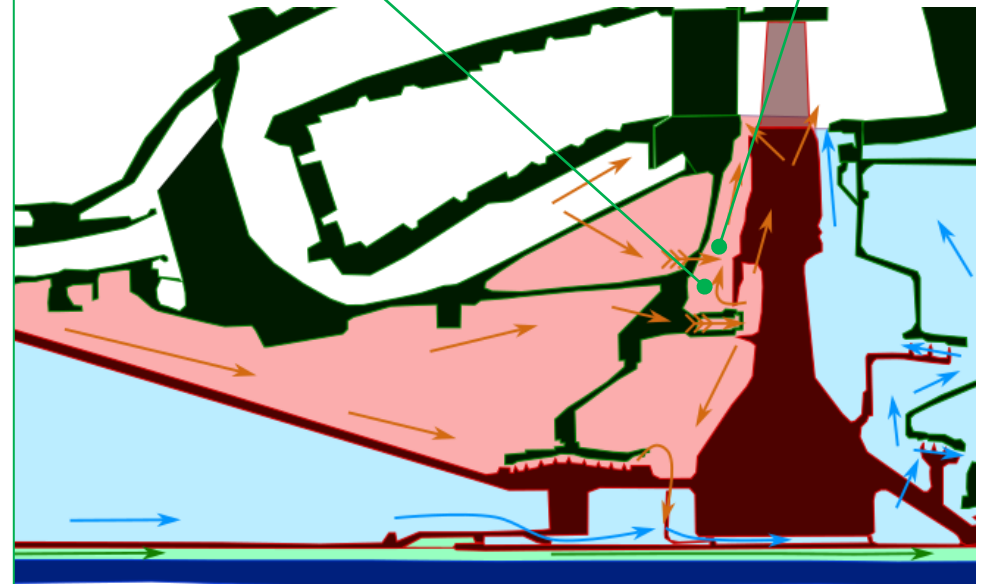
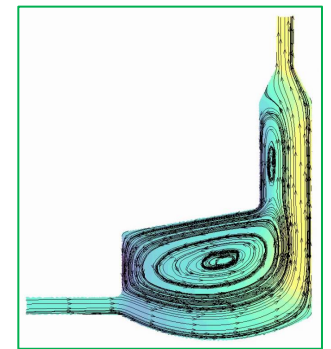
Co-rotating shafts



Preswirl cavity

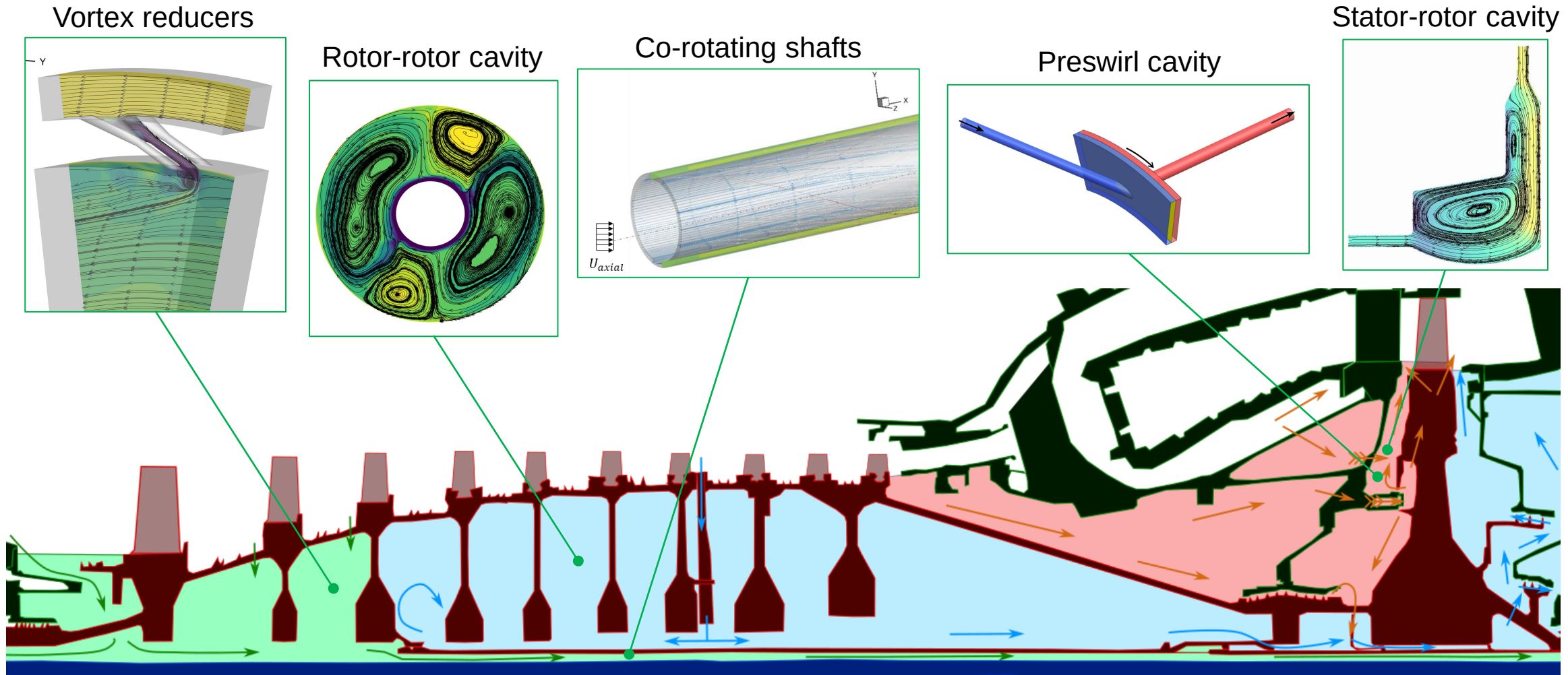


Stator-rotor cavity



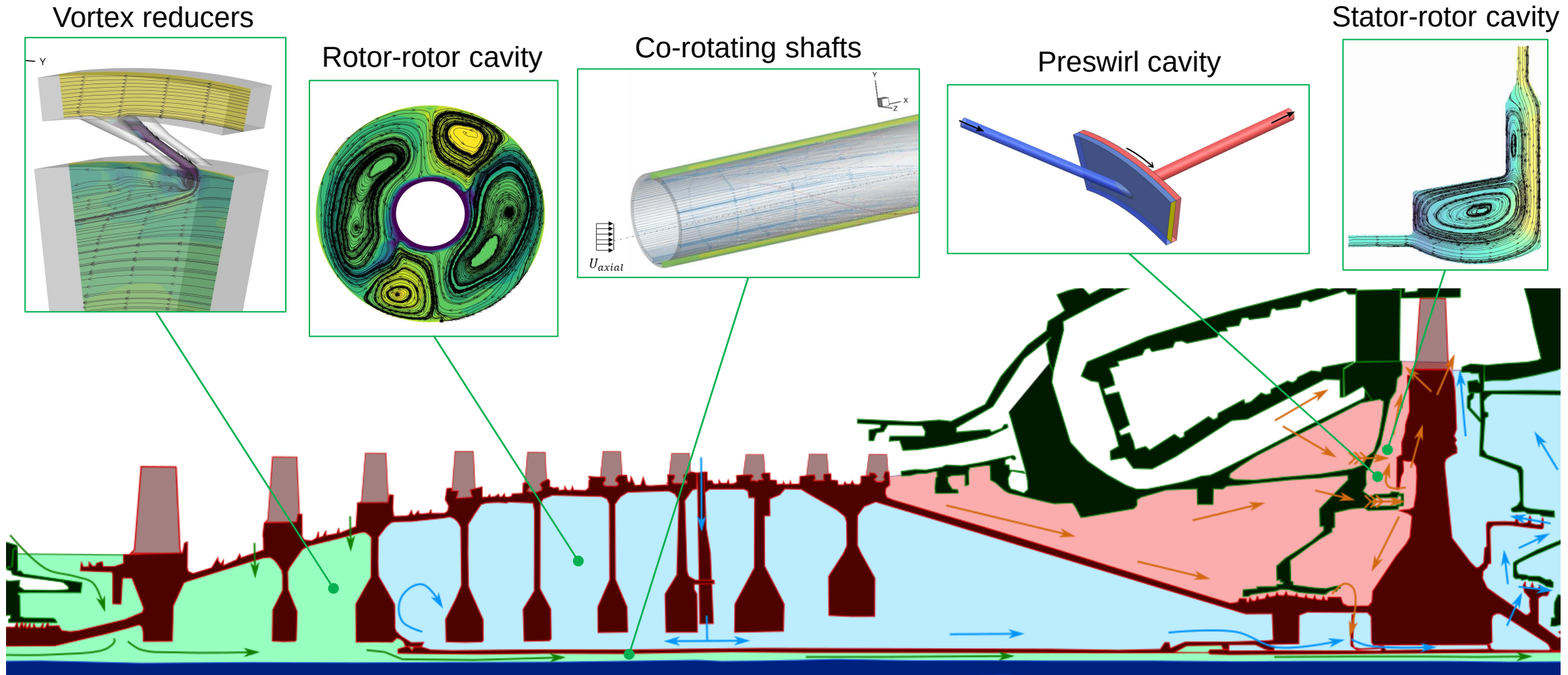
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Use Cases in Secondary Air System



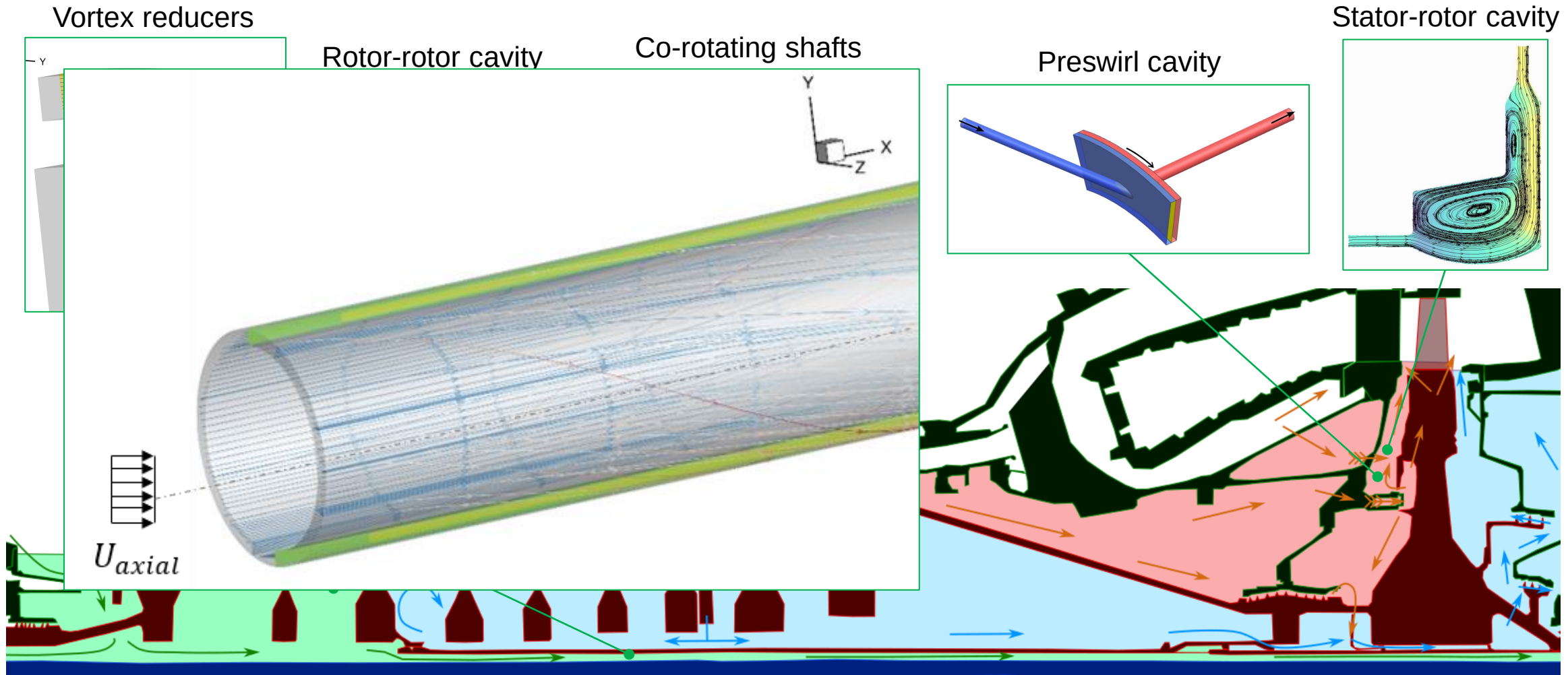
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Use Cases in Secondary Air System



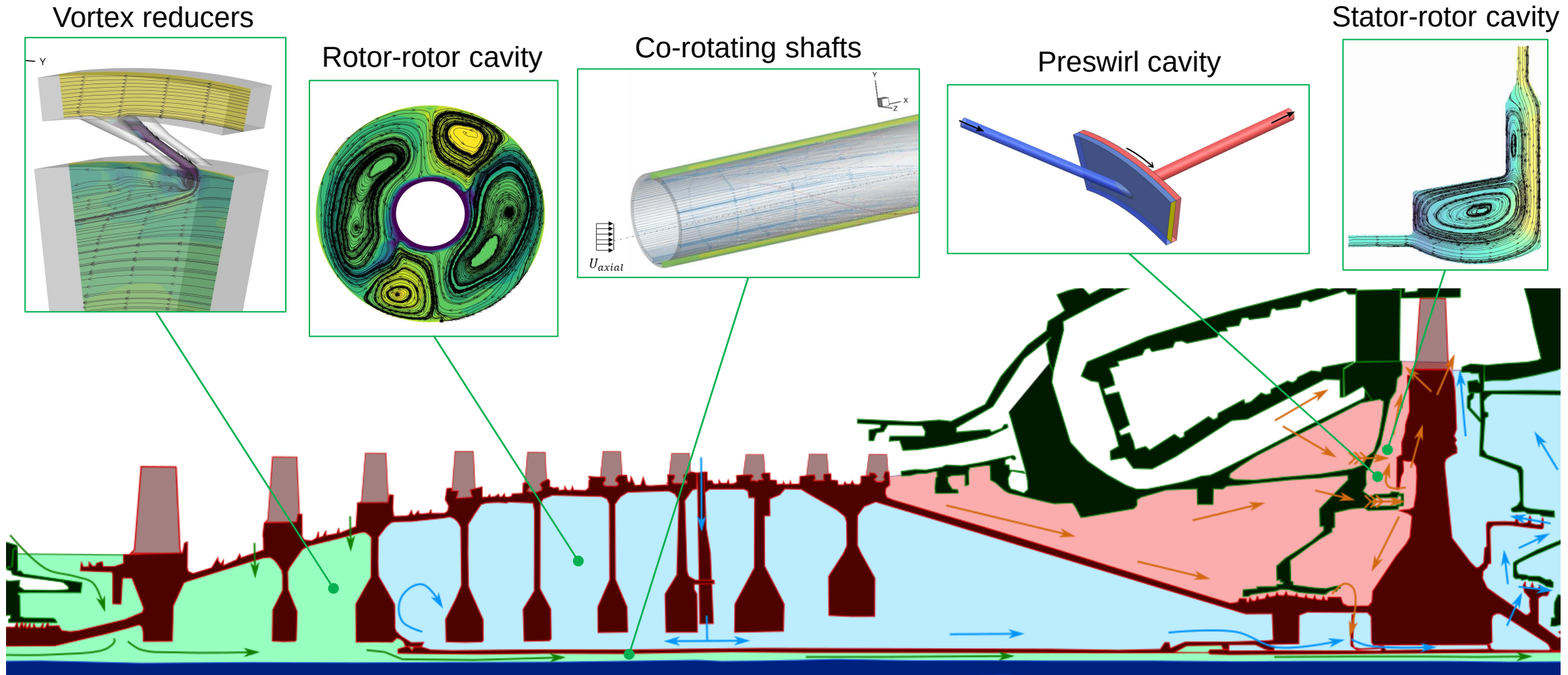
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Use Cases in Secondary Air System



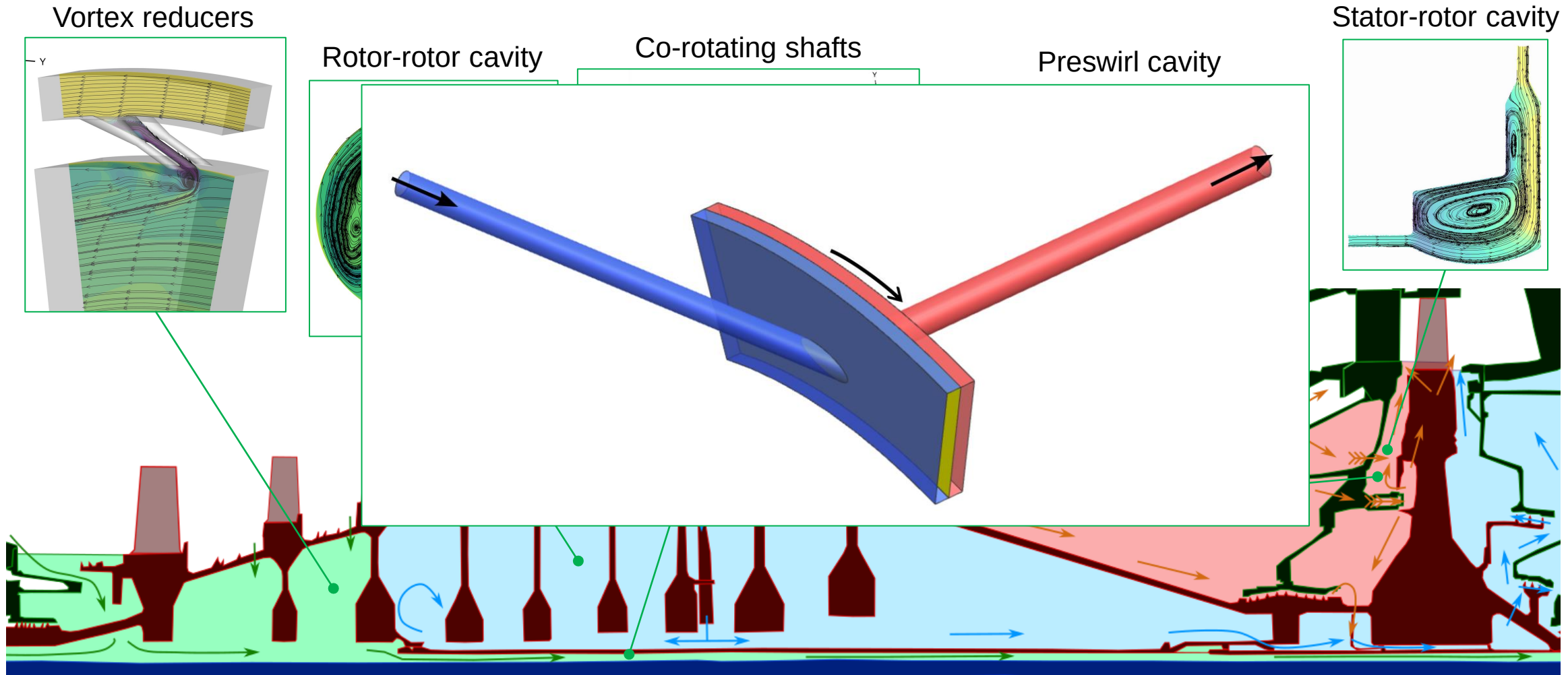
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Use Cases in Secondary Air System



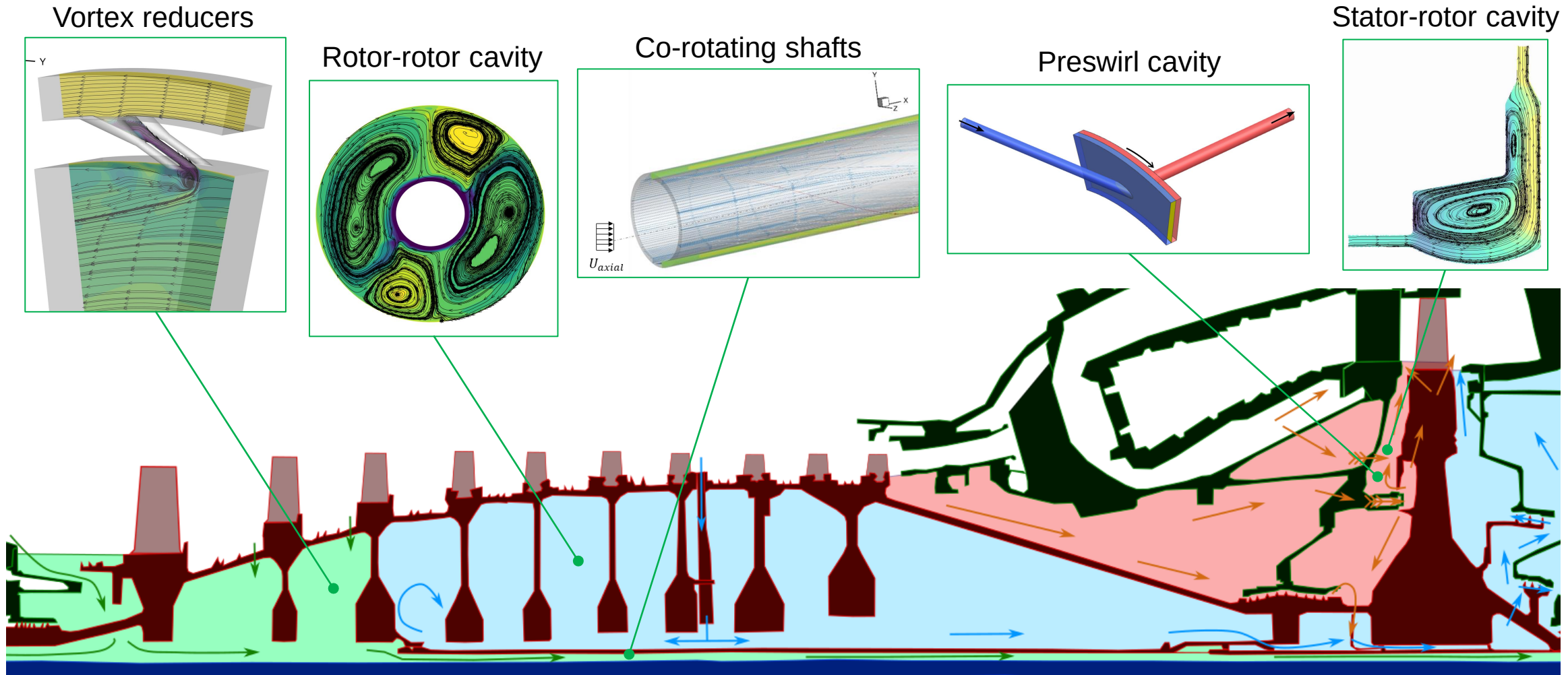
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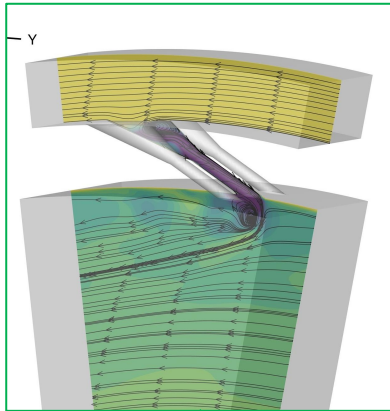
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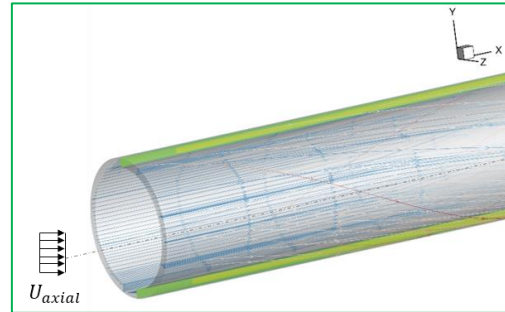
Vortex reducers



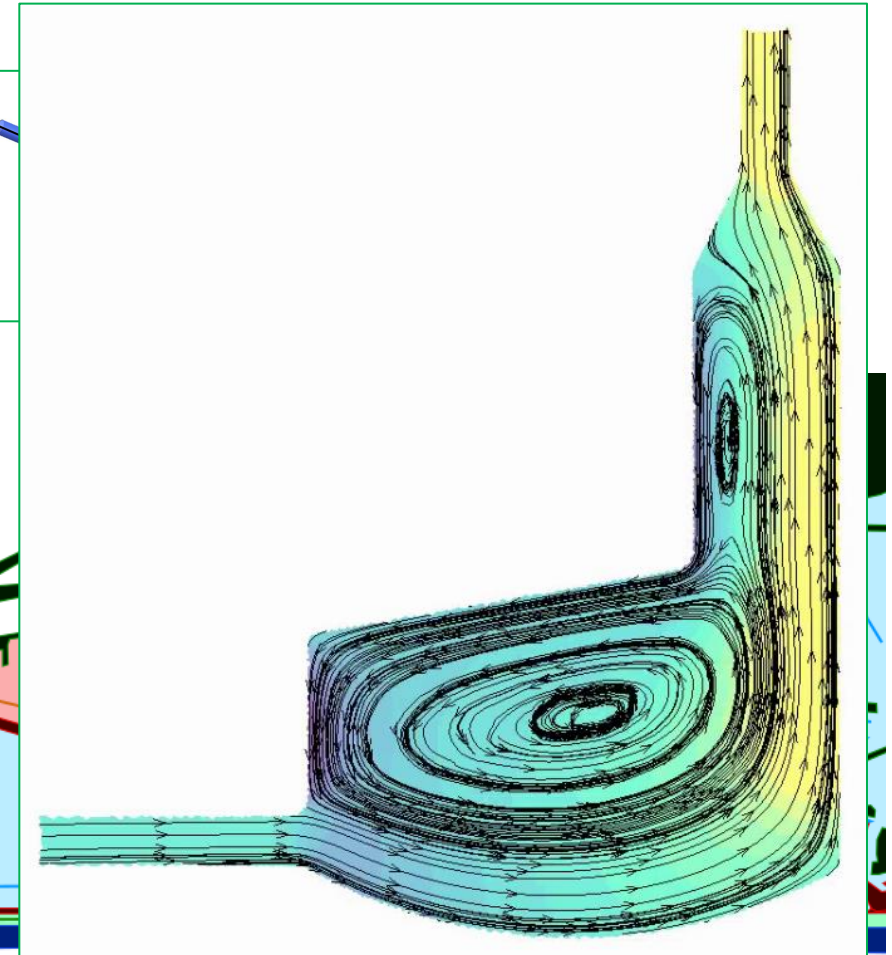
Rotor-rotor cavity



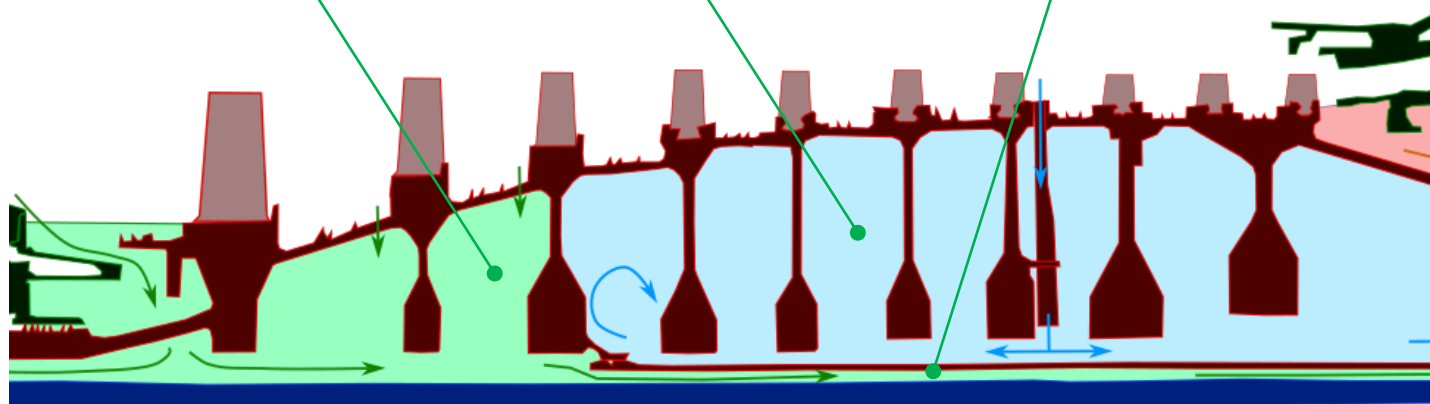
Co-rotating shafts



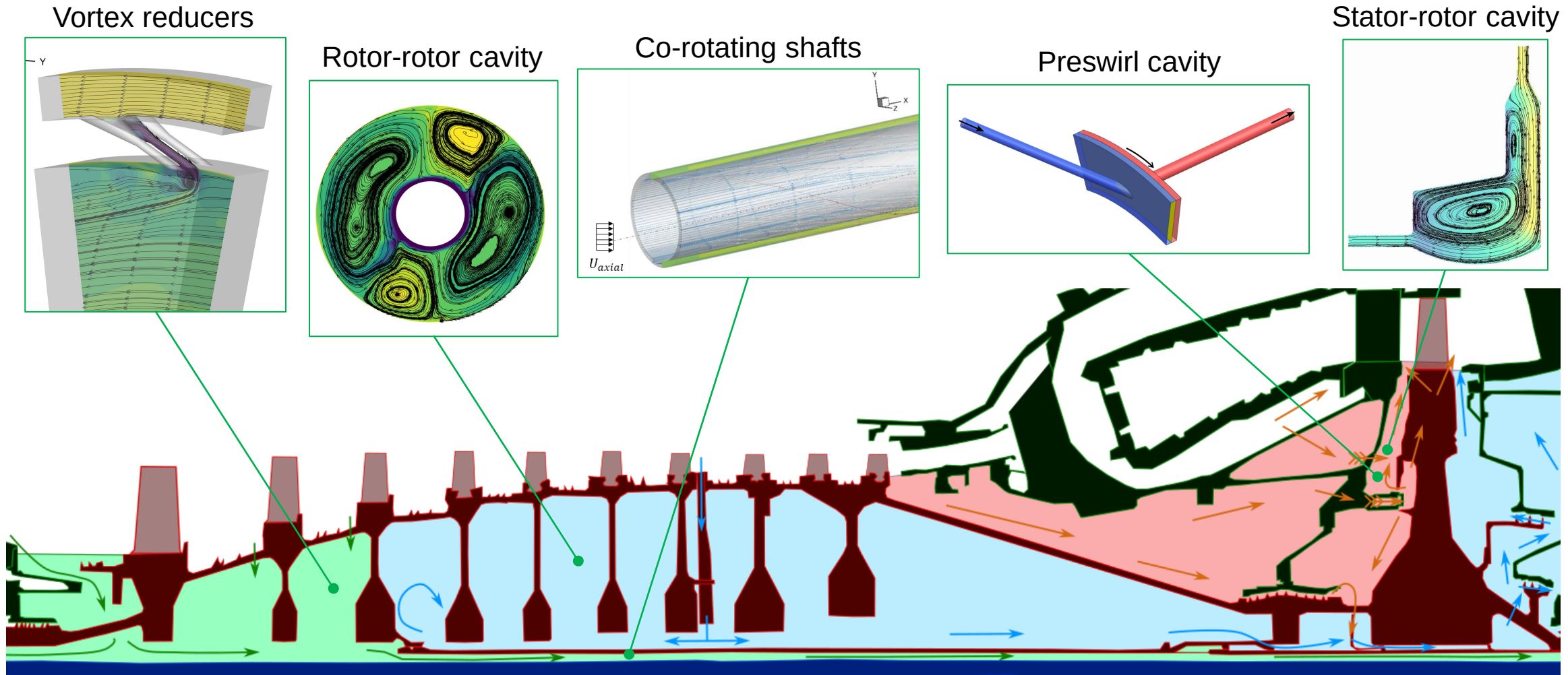
Stator-rotor cavity



based on NASA-CR-173084, 1981



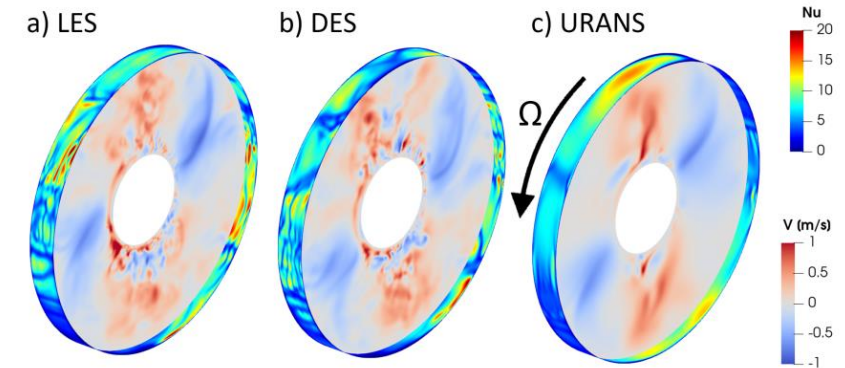
Use Cases in Secondary Air System



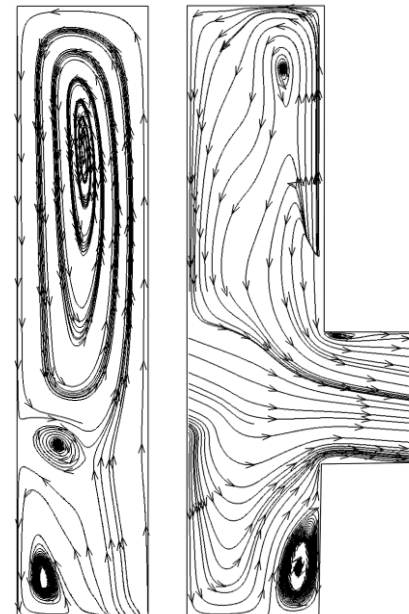
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Necessity of CFD in SAS

- Flow transitions with complex flow structures as a result of rotating, viscous, buoyant forces
- Necessity to understand heat transfer and pressure loss phenomena in highly unsteady flows with conjugate heat transfer
- Requirement of developing component correlation resulting from the lack of understanding of flow physics

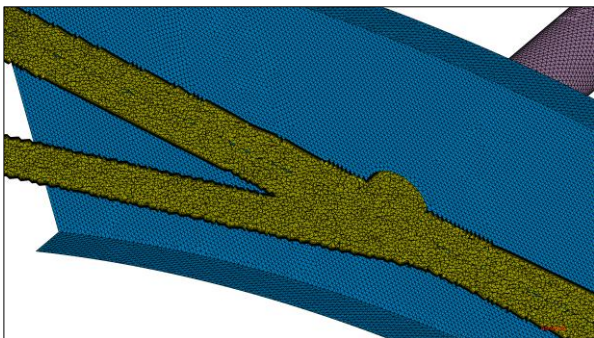


Radial velocity and Nusselt number on the shroud of rotating cavity, taken from Hickling 2020

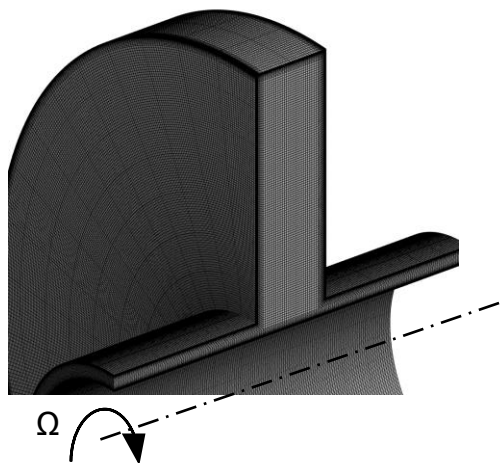


Vortex structures in the preswirl cavity

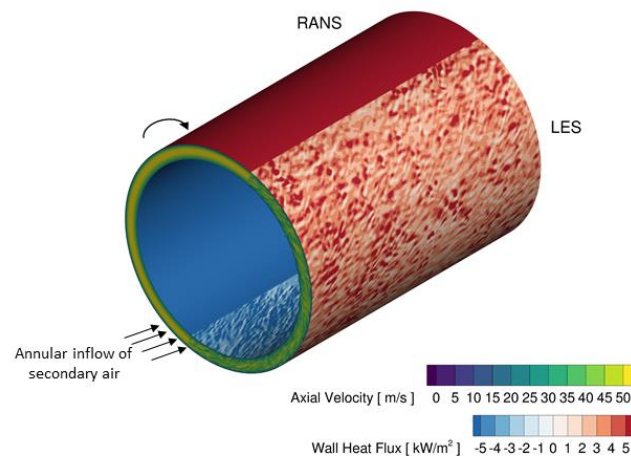
Current use of TRACE



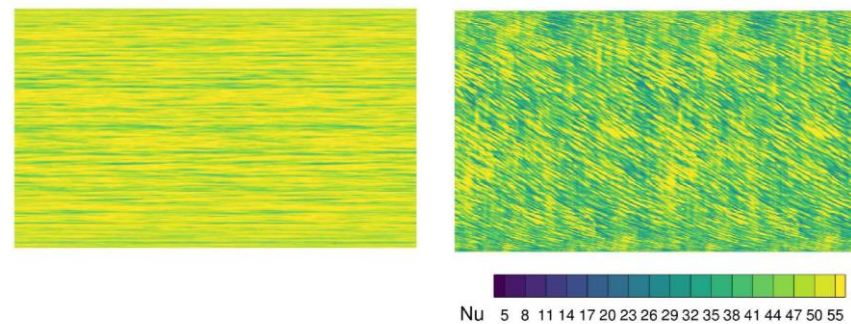
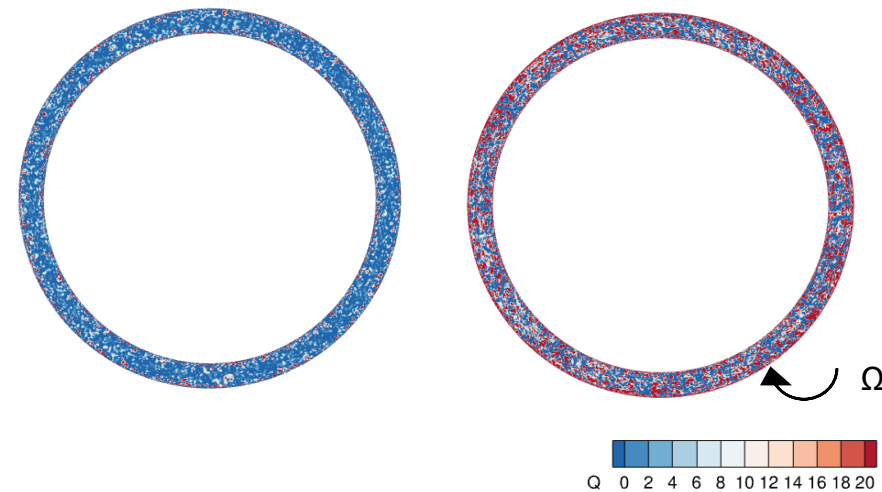
Unstructured mesh, preswirl cavity



Structured mesh, rotor-rotor cavity

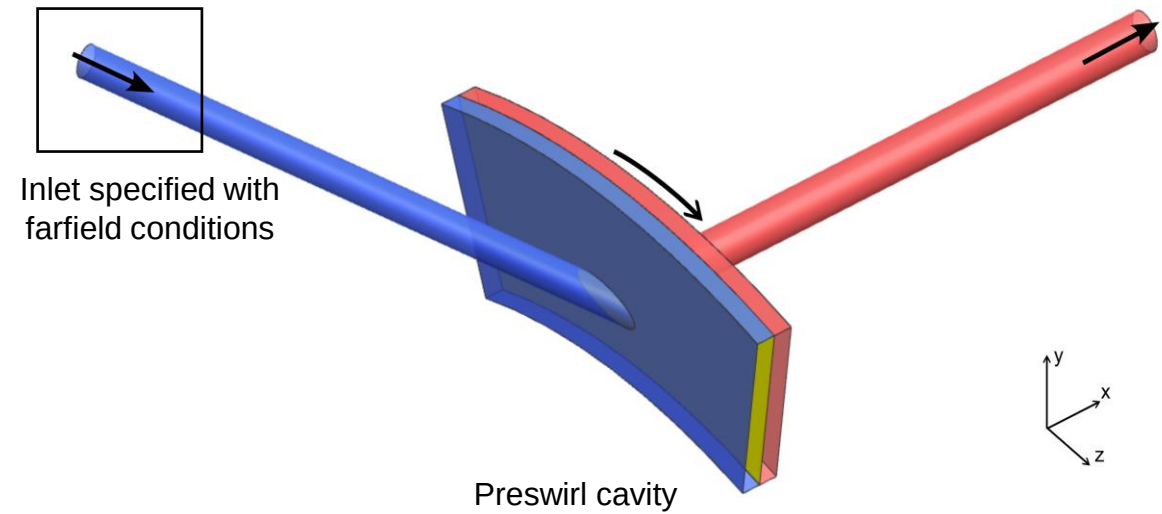
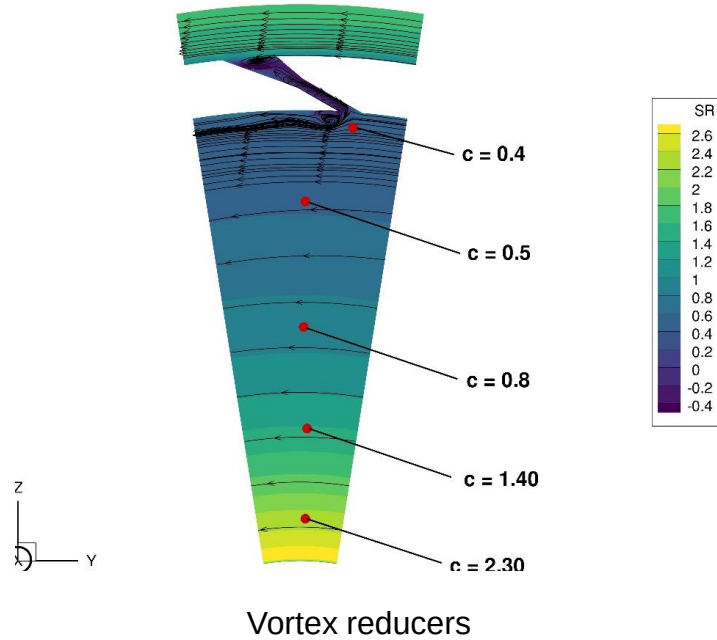


Steady and unsteady simulations of rotating cylinders



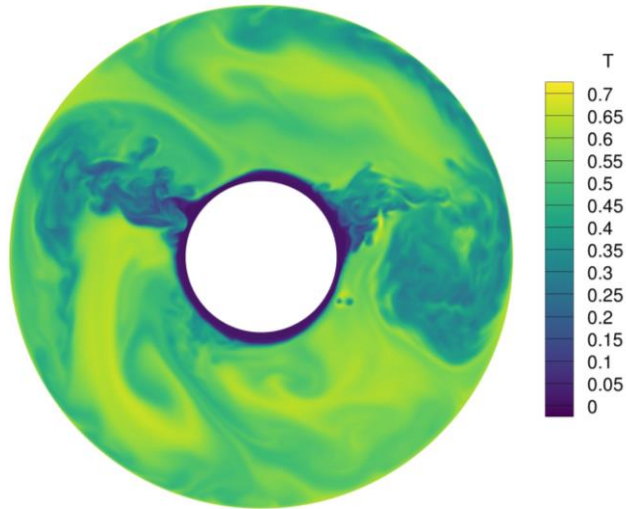
Flow and heat transfer computations on stationary and rotating annuli with streamwise periodicity

Future requirements

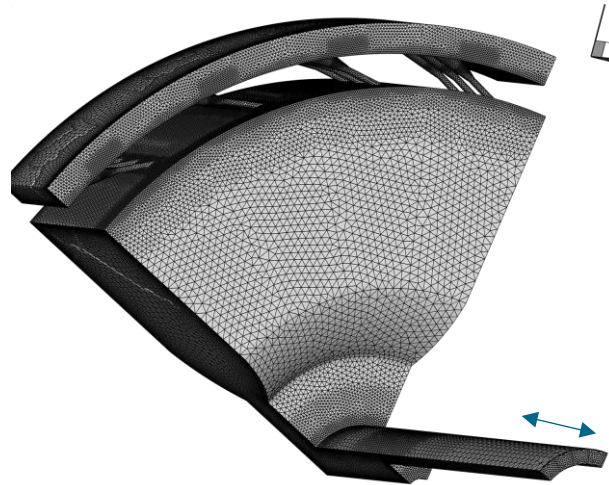


- Inlet swirl in vortex reducers: direct effects on pressure losses
- Inflow angles specification for variation of nozzle inclinations

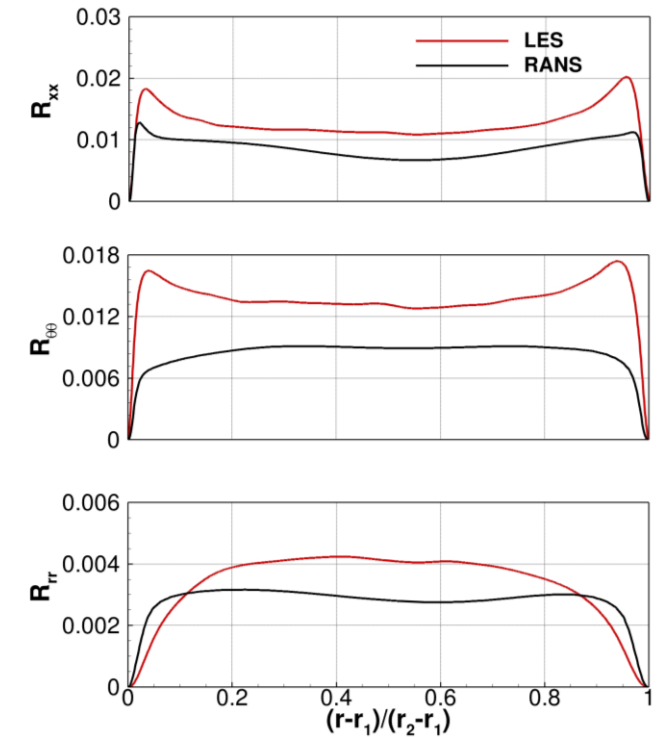
Applications of the CFD results



Understanding complex flow phenomena

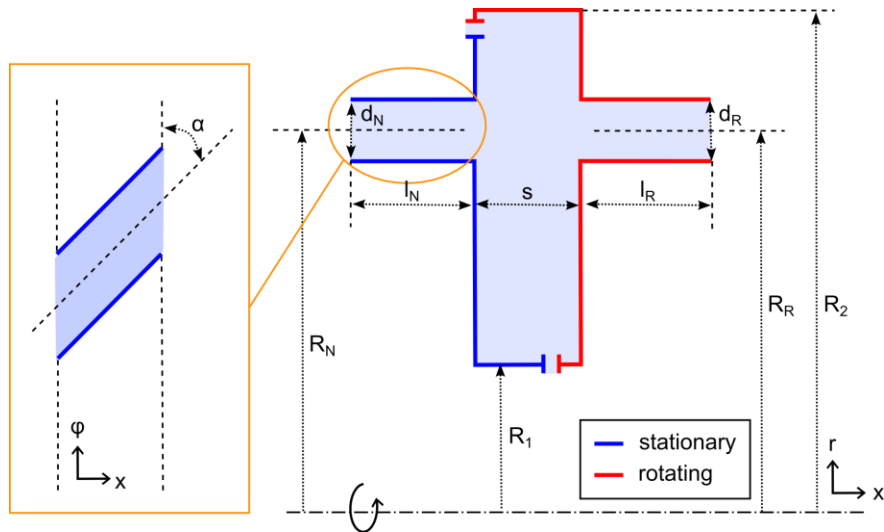


Identify the requirements in modeling

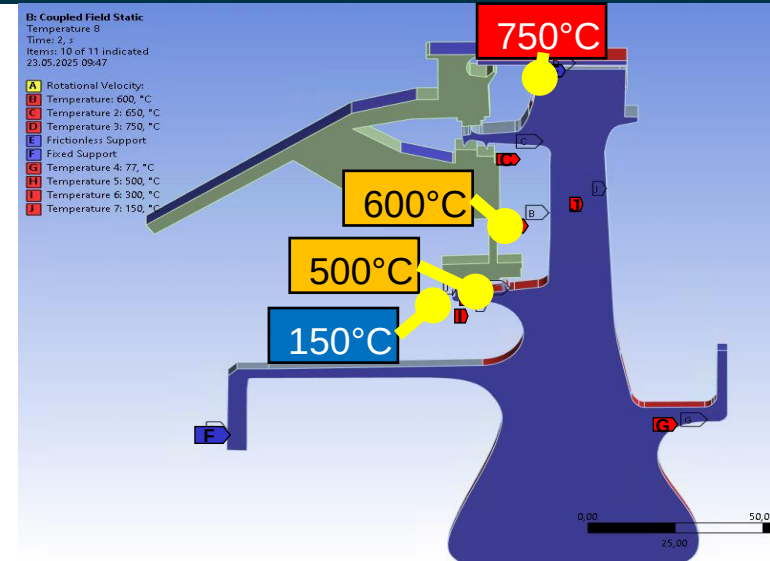


Identify the numerical requirements

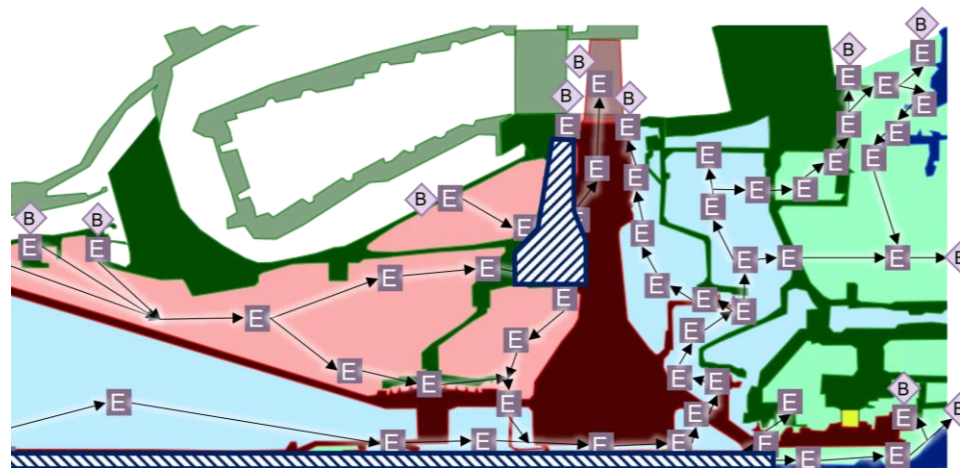
Applications of the CFD results



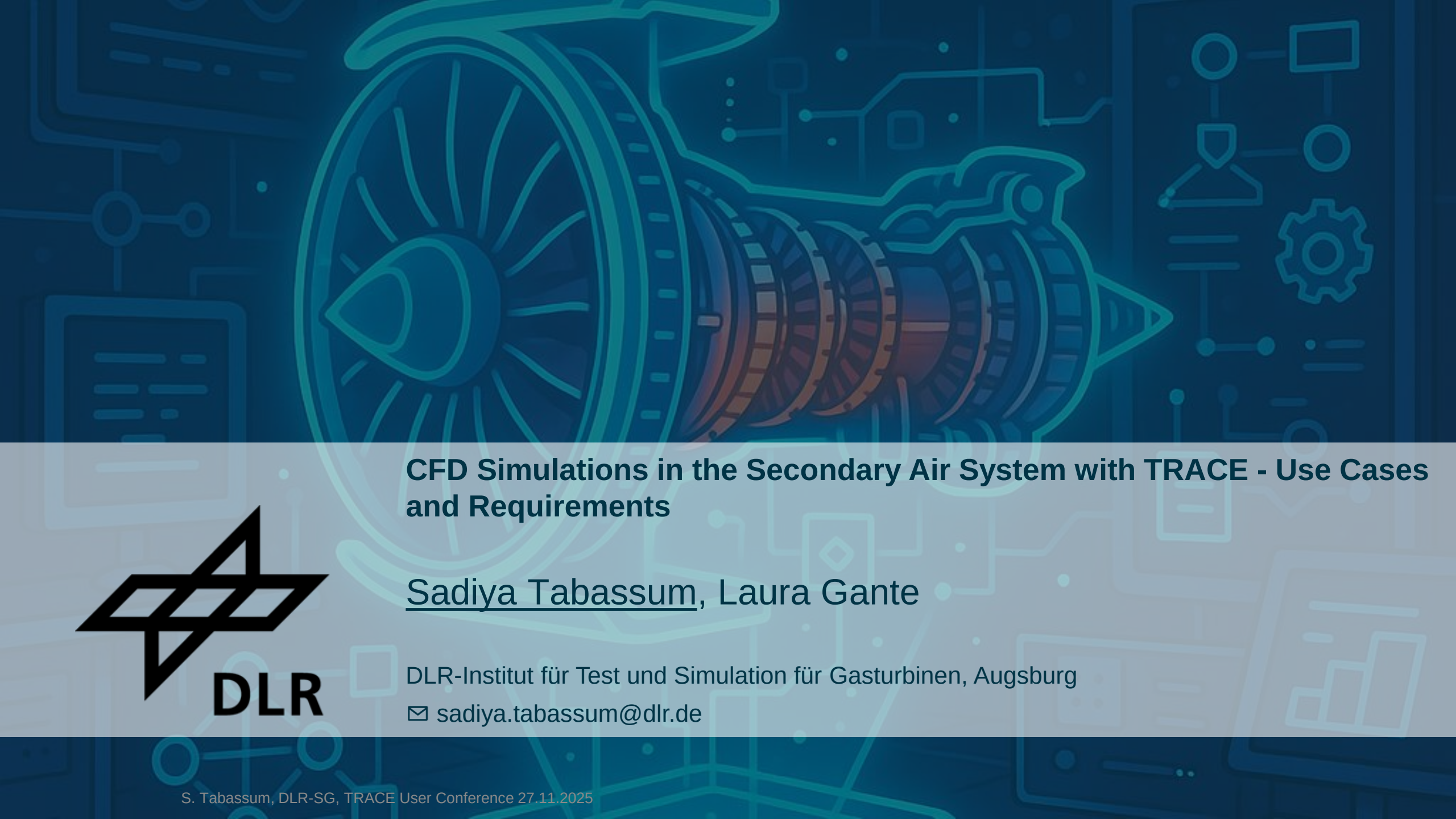
Study of the effect of geometric parameters on cooling supply



Fluid-structure interaction



Coupling of CFD with 1D SAS network model



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