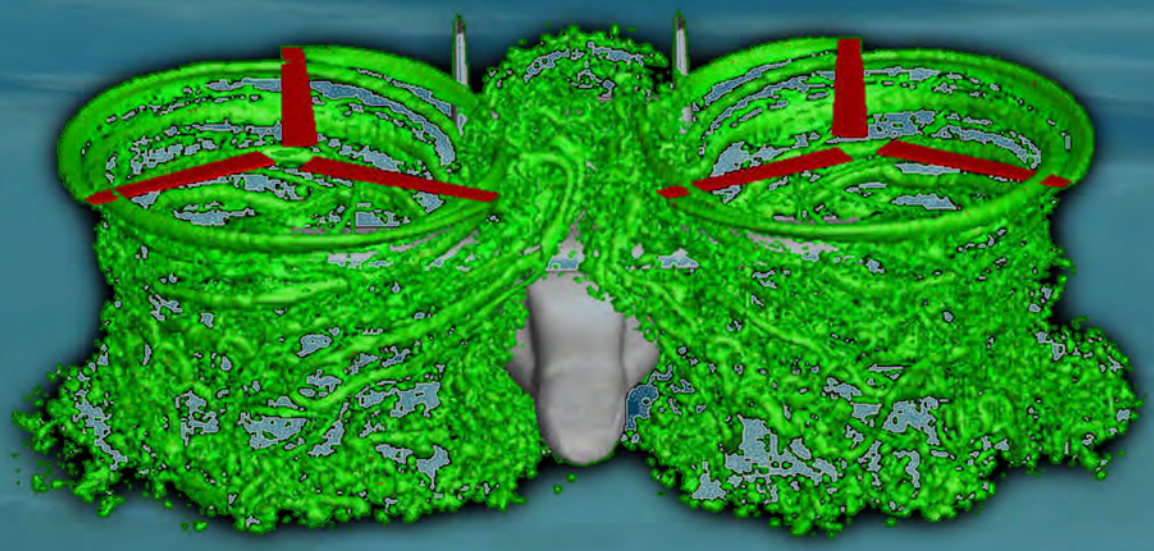
ADVANCED ROTORCRAFT TECHNOLOGY

A LEADER IN ROTORCRAFT SIMULATION



Viscous Vortex Particle Method (VVPM)

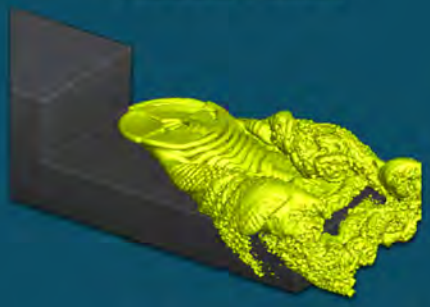
A state-of-the-art solution to complicated aerodynamic interaction problems for multiple rotor/wing configurations

- First Principle based fluid dynamics solution
- Accurate and efficient prediction of rotor/wing wake dynamics and interference
- Preserves coherent vortex structures for long time/distance
- No ad-hoc empirical modeling parameters (core size, rollup, etc.)
- Easily coupled with lifting line, lifting surface, and CFD
- Robust and efficient tool suited for design, engineering analysis, and simulation
- Validated for assorted rotorcraft configurations under various flight conditions
- Suitable for interactional aerodynamics modeling of multiple rotor eVTOL and FVL configurations

ART

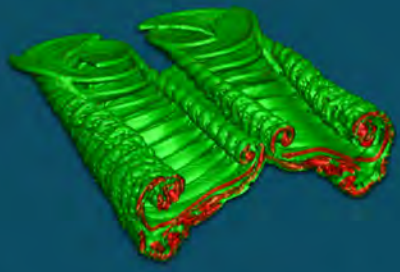
The Viscous Vortex Particle Method (VVPM) is designed to solve complicated aerodynamic interaction problems for multiple rotor, wing, and ducted fan configurations. With the first principle formulation, VVPM efficiently solves the incompressible Navier-Stokes equation in a vorticity-velocity form with a grid-free Lagrangian representation. It accurately convects the vorticity in the flow-field for a long duration without any artificial dissipation while still capturing the wake distortion and diffusion due to air viscosity. The VVPM tool is best suited for modeling rotorcraft aerodynamic interaction problems such as rotor/wing/fan, rotors/fuselage, and rotor/ship superstructure. VVPM is fully parallelized with GPUs and is extremely efficient using a PC equipped with a GPU card. VVPM can be coupled with either a lifting line-based blade element or lifting surface model or a CFD solver. The coupled VVPM/CFD simulation renders a hybrid flow solver that maximizes the benefits of both the VVPM and CFD solvers. The VVPM based flow solver has been extensively validated for different rotorcraft/compound aircraft configurations, including single main rotor, co-axial, tiltrotor, and quadrotor under various flight conditions, such as hover, low/high speed, level flight, climb/descent, vortex ring state, and operations in and out of ground effect.

Rotor/Ship

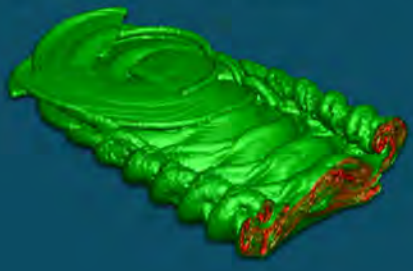


Rotor/Fuselage

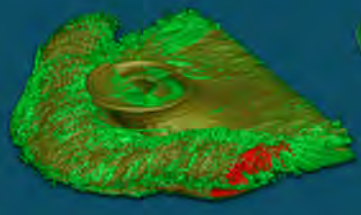
Tilt Rotors



Coaxial Rotors



Rotor/Ground



Single Rotor

Quad Rotors

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