Bauhaus-Universität Weimar

Institute of Structural Engineering
Chair of Modelling and Simulation of Structures
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VXflow – A Computational Fluid Dynamics (CFD) solver

Abstract

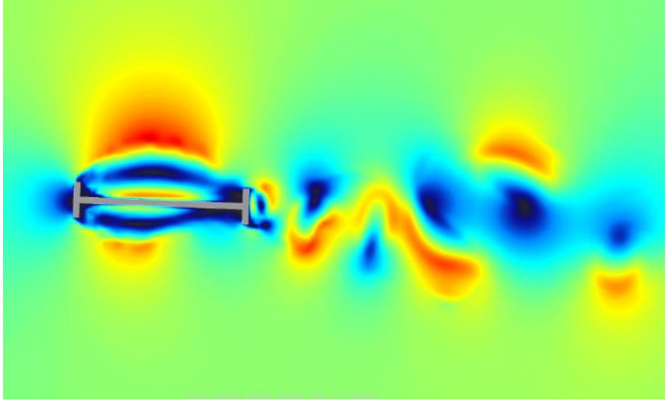
VXflow is flow a Computational Fluid Dynamics (CFD) solver that enables simulation of complicated aerodynamic behavior of bluff bodies and aeroelastic phenomena such as vortex-induced vibrations, flutter galloping occurring during fluid-structure interaction. It is based on the 2D meshless Vortex Particle Method (VPM) utilizing immersed interface technique for the Vortex-In-Cell algorithm that allows simulation of flows past bodies with complicated geometries at high Reynolds number. The core code was developed by Prof. Dr. Guido Morgenthal as part of his PhD work at the Engineering Department of Cambridge University. It has been verified and validated on numerous occasions, including extensive scientific as well as practical applications by several research groups and companies. Throughout the years, several new extensions have been introduced by researchers at the Chair of Modelling and Simulations of Structures, making the software presently relevant with cutting edge features. Some of the features and modules offered by the software include:

- Aerodynamic analyses for extraction of aerodynamic coefficients for bluff bodies and direct aeroelastic analyses including structural dynamics [12-16]
- Pseudo-3D modeling of line-like structures such as long-span bridges with variable cross section for multimodal aeroelastic analyses [1,9,15,16]
- Highly efficient GPU and OpenCL parallel architecture for both Windows and Linux platforms [9]
- Adaptive re-meshing algorithm for increasing computational efficiency while retaining accuracy [12,14,15]
- Extension for thin-wall flexible systems with high order structural nonlinearity [2,6]
- VXturb, a module for deterministic and random free-stream turbulence for 2D and correlated Pseudo-3D aerodynamic and aeroelastic analyses [1,2,3,4,7]
- VXpost and VXviz, modules for user-friendly post-process and detailed visualization

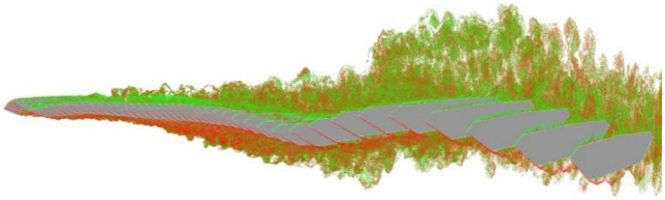
Related projects

The code has been applied for aerodynamic studies on the following structures:

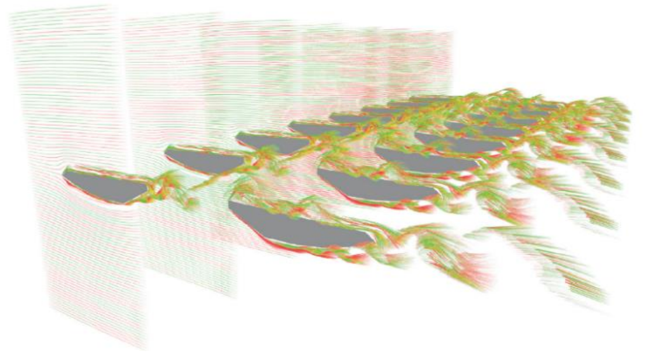
Viaduc de Millau, Stretto di Messina, Tacoma Narrows Bridge, M4 Neath Viaduct, Storebelt Bridge, Glasgow Wing Tower, Chenab Bridge, Strelasund Bridge, 2nd Orinoco Bridge, Bukhang North Harbour Bridge, MaChang Bridge



2D simulation of flow around a H-section



Flutter analysis of Great Belt bridge using Pseudo-3D vortex method



Buffeting analysis of Stonecutters bridge using Pseudo-3D vortex method with free-stream turbulence. The inflow turbulence is modeled by seeding vorticity carrying particles in the upstream.

Collaboration

University of Cambridge, Department of Engineering
University of British Columbia, Vancouver, Department of Theoretical Physics
University of Stuttgart, Department of Civil and Structural Engineering
BMT Fluid Mechanics
Leonhardt, Andrä und Partner, Stuttgart

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Related publications

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