

## Flow Reproduction Using Vortex Particle Methods for Wake Buffeting Analysis of Bluff Structures

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**Abstract :** The paper presents a novel extension of Vortex Particle Methods (VPM) where the study aims to reproduce a template simulation of complex flow field that is generated from impulsively started flow past an upstream bluff body at certain Reynolds number. Re-Vibration of a structural system under upstream wake flow is often considered its governing design criteria. Therefore, the attention is given in this study especially for the reproduction of wake flow simulation. The basic methodology for the implementation of the flow reproduction requires the downstream velocity sampling from the template flow simulation; therefore, at particular distances from the upstream section the instantaneous velocity components are sampled using a series of square sampling-cells arranged vertically where each of the cell contains four velocity sampling points at its corner. Since the grid free Lagrangian VPM algorithm discretises vorticity on particle elements, the method requires transformation of the velocity components into vortex circulation, and finally the simulation of the reproduction of the template flow field by seeding these vortex circulations or particles into a free stream flow. It is noteworthy that the vortex particles have to be released into the free stream exactly at same rate of velocity sampling. Studies have been done, specifically, in terms of different sampling rates and velocity sampling positions to find their effects on flow reproduction quality. The quality assessments are mainly done, using a downstream flow monitoring profile, by comparing the characteristic wind flow profiles using several statistical turbulence measures. Additionally, the comparisons are performed using velocity time histories, snapshots of the flow fields, and the vibration of a downstream bluff section by performing wake buffeting analyses of the section under the original and reproduced wake flows. Convergence study is performed for the validation of the method. The study also describes the possibilities how to achieve flow reproductions with less computational effort.

**Keywords :** vortex particle method, wake flow, flow reproduction, wake buffeting analysis

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