A High Order Approach to Solving Nonlinear Differential Equations Applied to a Pelton Turbine Bucket

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ABSTRACT

A method for solving nonlinear differential equations, which facilitates the computation of solutions of a high polynomial degree on a grid [1], is tested for use in numerical simulation of two-phase fluid flow over a Pelton wheel bucket.

The method is a finite element type of approach and uses a grid discretization to approximate continuously distributed variables, represented by functions of time and space, in a given set of differential equations. The grid contains information about both the values and the values of the derivatives of the unknown functions at the grid points in the computational domain. With this method the derivatives are thus explicitly defined at each grid point rather than, as in conventional numerical schemes, implicitly given by the function values at the surrounding grid points. Using piecewise polynomial interpolation functions can be represented with an arbitrary order of continuity over the entire computational domain.

The high polynomial order used in this method allows for simulation of flow features smaller than the interval separating each grid point. This reduces the required number of grid points and the need to adapt the grid to complex boundary geometry or to the interface between different fluid phases. This simplifies grid generation and reduces the computational cost for some cases.

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REFERENCES

[1] J. Tveit, “A Numerical Approach to Solving Nonlinear Differential Equations on a Grid with Potential Applicability to Computational Fluid Dynamics”, *arXiv*, 1409.1072, (2014).