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Inclusion of Hydrodynamic Dispersion in Fluid Flow Computations Using the Complex Variable Boundary Element Method

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The complex variable boundary element method (CVBEM) has been successfully applied to convective flow problems. This study aims at extending the applicability of the CVBEM to convective-dispersive flow problems. In order to utilize the analytical solutions obtained for one-dimensional (1D) problems, two-dimensional (2D) transport is decomposed into transport along multiple 1D streamlines. Varying velocity along the streamlines can be taken into account with a set of coordinate transformations τ and ω. The CVBEM is suitable for streamline tracking and yields accurate evaluations of τ and ω. Along each streamline, 1D transport is analytically modeled, and the complete 2D solution is recovered by combining the individual 1D solutions. The developed method is verified against a diverging radial flow problem and applied to some example problems. Tracer concentration profiles and effluent concentration curves, which can directly be constructed from the analytical solutions, are of use for evaluating hydrodynamic characteristics.

Keywords: Dispersion, Streamline, CVBEM, Solute transport

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