HYDRAULIC PERFORMANCE GRAPH-BASED MODEL FOR UNSTEADY FLOW SIMULATIONS IN TOPOLOGICALLY COMPLEX RIVER NETWORKS

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A robust and numerically efficient model for unsteady flow routing through dendritic, looped and networks comprised of dendritic and looped sub-networks is presented here. The model builds upon the application of Hydraulic Performance Graph (HPG) to unsteady flow routing introduced by González-Castro and Yen (2000) and adopts the Volume Performance Graph (VPG) introduced by Hoy and Schmidt (2006). The HPG of a channel reach graphically summarizes the dynamic relation between the flow through and the stages at the ends of the reach under gradually varied flow (GVF) conditions, while the VPG summarizes the corresponding storage. Both, the HPG and VPG are unique to a channel reach with a given geometry and roughness, and can be computed decoupled from unsteady boundary conditions by solving the GVF equation for all feasible conditions in the reach. The use of HPG's and VPG's for unsteady flow routing through a general channel network adopted in the proposed model makes it numerically efficient and highly robust because most of the computations involve only interpolation steps. In our model (OSU Rivers) we solve a system of nonlinear equations assembled based on information summarized in the systems' HPG's and VPG's, continuity and compatibility conditions at the union of reaches (nodes), and the system boundary conditions. We exemplify the applicability of OSU Rivers to looped networks and contrast its simulation results with those from the well-known unsteady HEC-RAS model.

References:

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