

# Going with the (Information) Flow: on fast numerical methods for boundary value problems

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ABSTRACT

The fundamental principle, that the direction of information propagation can be used to de-couple certain systems of nonlinear equations, is the basis of Dijkstra's classical method for finding shortest paths on graphs.

We will use the continuous analogue of this principle to build efficient (non-iterative) numerical methods for a wide class of static first-order partial differential equations. We will treat a number of problems in continuous and hybrid optimal control (e.g., optimal traveling on foot and using the buses), in anisotropic front propagation (e.g., first-time arrivals in seismic imaging), in optimal control under uncertainty (e.g., optimal traveling when the map is not quite known), and in dynamical systems (e.g., reconstruction of invariant manifolds for systems with multiple time-scales).