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A Family of Convective-Like Energy-Stable Outflow Boundary Conditions for Incompressible Flow Simulations on Severely-Truncated Unbounded Domains[1] SUCHUAN DONG, Purdue University — A large class of flow problems are spatially developing and involves physically unbounded domains, e.g. wakes, jets, and shear layers. To numerically simulate such problems, it is necessary to truncate the domain to a finite size, and some open boundary condition (a.k.a. outflow boundary condition) will be required at the artificial boundary. Backflow instability is a commonly encountered issue with outflows or open boundaries at moderate and high Reynolds numbers. Simulations have been observed to instantly blow up when strong vortices or backflows occur at the outflow/open boundary. In this talk we present a family of convective-like open boundary conditions that effectively overcomes the backflow instability. A prominent feature of these boundary conditions is that they all ensure the energy stability of the system, even in situations where strong vortices or backflows occur at the outflow/open boundary. The proposed boundary conditions unify and provide an underlying connection between the usual convective boundary condition and the traction-free boundary condition. Several canonical wake and jet problems in open domains will be presented to demonstrate the accuracy and effectiveness of the method for overcoming backflow instability.

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