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Modified one-way Navier-Stokes equations with PSE-like cost. MIN ZHU, AARON TOWNE, University of Michigan, FLOW MODELING AND CONTROL TEAM — Spatial marching methods offer a low-cost alternative to global linear methods and direct numerical simulation for studying the linear and nonlinear stability of slowly varying flows, e.g., boundary layers and jets. The widely used parabolized stability equations (PSE) provide adequate accuracy in some cases, but tend to fail, due to regularization required to overcome the ill-posedness of the spatial march, for flows involving multiply instability mechanisms, transient growth, and acoustics. An alternative method called the One-Way Navier-Stokes equations (OWNS) uses a recursive filter to yield a formally well-posed spatial march that can accurately capture the entire downstream solution, but at one to two orders-of-magnitude higher computational cost than PSE. In this presentation, we introduce a modified OWNS method with cost approaching that of PSE. The speedup is achieved by modifying the OWNS recursion equations to achieve better cost scaling and by borrowing ideas from PSE while still avoiding its limitations. The accuracy and efficiency of the method are demonstrated using a hypersonic boundary layer and a turbulent jet..

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