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Discrete adjoint of fractional step Navier-Stokes solver in generalized coordinates[1] MENGZE WANG, VINCENT MONS, TAMER ZAKI, Johns Hopkins Univ — Optimization and control in transitional and turbulent flows require evaluation of gradients of the flow state with respect to the problem parameters. Using adjoint approaches, these high-dimensional gradients can be evaluated with a similar computational cost as the forward Navier-Stokes simulations. The adjoint algorithm can be obtained by discretizing the continuous adjoint Navier-Stokes equations or by deriving the adjoint to the discretized Navier-Stokes equations directly. The latter algorithm is necessary when the forward-adjoint relations must be satisfied to machine precision. In this work, our forward model is the fractional step solution to the Navier-Stokes equations in generalized coordinates, proposed by Rosenfeld, Kwak & Vinokur [J. Comput. Phys **94**, 102-137 (1991)]. We derive the corresponding discrete adjoint equations. We also demonstrate the accuracy of the combined forward-adjoint model, and its application to unsteady wall-bounded flows.

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Mengze Wang
Johns Hopkins Univ

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