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A low-cost RK time advancing strategy for energy-preserving turbulent simulations FRANCESCO CAPUANO, GENNARO COPPOLA, LUIGI DE LUCA, University of Naples Federico II, GUILLAUME BALARAC, LEGI University of Grenoble — Energy-conserving numerical methods are widely employed in direct and large eddy simulation of turbulent flows. Semi-discrete conservation of energy is usually obtained by adopting the so-called skew-symmetric splitting of the non-linear term, defined as a suitable average of the divergence and advective forms. Although generally allowing global conservation of kinetic energy by convection, it has the drawback of being roughly twice as expensive as standard divergence or advective forms alone. A novel time-advancement strategy that retains the conservation properties of skew-symmetric-based schemes at a reduced computational cost has been developed in the framework of explicit Runge-Kutta schemes. It is found that optimal energy-conservation can be achieved by properly constructed Runge-Kutta methods in which only divergence and advective forms for the convective term are adopted. The new schemes can be considerably faster than skew-symmetric-based techniques. A general framework for the construction of optimized Runge-Kutta coefficients is developed, which has proven to be able to produce new methods with a specified order of accuracy on both solution and energy. The effectiveness of the method is demonstrated by numerical simulation of homogeneous isotropic turbulence.

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