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OPTIMIZING RUNGE-KUTTA SMOOTHERS FOR UNSTEADY FLOW PROBLEMS*

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Abstract. We consider the solution of unsteady viscous flow problems by multigrid methods employing Runge-Kutta smoothers. Optimal coefficients for the smoothers are found by considering the unsteady linear advection equation and performing a Fourier analysis, respectively, looking at the spectral radius of the multigrid iteration matrix. The new schemes are compared to using a classic dual time stepping approach, where the scheme for the steady state equation is reused, meaning that the smoother coefficients are obtained by an optimization based on the steady state equations, showing significant improvements.

Key words. Multigrid, unsteady flows, finite volume methods, explicit Runge-Kutta methods, linear advection equation

AMS subject classifications. 35L04, 35Q35, 65F10, 65L06, 65M08

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