NEWTON-LIKE INERTIAL DYNAMICS AND PROXIMAL ALGORITHMS GOVERNED BY MAXIMALLY MONOTONE OPERATORS*

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Abstract. The introduction of the Hessian damping in the continuous version of Nesterov's accelerated gradient method provides, by temporal discretization, fast proximal gradient algorithms where the oscillations are significantly attenuated. We will extend these results to the maximally monotone case. We rely on the technique introduced by Attouch-Peypouquet (Math. Prog. 2019), where the maximally monotone operator is replaced by its Yosida approximation with an appropriate adjustment of the regularization parameter. In a general Hilbert framework, we obtain the weak convergence of the iterates to equilibria, and the rapid convergence of the discrete velocities to zero. By specializing these algorithms to convex minimization, we obtain the convergence rate $o\left(1/k^2\right)$ of the values, and the rapid convergence of the gradients towards zero.

Key words. Damped inertial dynamics; Hessian damping; large step proximal method; Lyapunov analysis; maximally monotone operators; Newton method; time-dependent viscosity; vanishing viscosity; Yosida regularization.

AMS subject classifications. 37N40, 46N10, 49M30, 65K05, 65K10, 90B50, 90C25.

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