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INERTIAL METHODS WITH VISCOUS AND HESSIAN DRIVEN DAMPING FOR NON-CONVEX OPTIMIZATION

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In this work, we aim to study non-convex minimization problems via second-order (in-time) dynamics, including a non-vanishing viscous damping and a geometric Hessian-driven damping. Second-order systems that only rely on a viscous damping may suffer from oscillation problems towards the minima, while the inclusion of a Hessian-driven damping term is known to reduce this effect without explicit construction of the Hessian in practice. There are essentially two ways to introduce the Hessian-driven damping term: explicitly or implicitly. For each setting, we provide conditions on the damping coefficients to ensure convergence of the gradient towards zero. Moreover, if the objective function is definable, we show global convergence of the trajectory towards a critical point as well as convergence rates. Besides, in the autonomous case, if the objective function is Morse, we conclude that the trajectory converges to a local minimum of the objective for almost all initializations. We also study algorithmic schemes for both dynamics and prove all the previous properties in the discrete setting under proper choice of the step-size.

References

[1] Rodrigo Maulen-Soto and Jalal Fadili and Peter Ochs: *Inertial Methods with Viscous and Hessian driven Damping for Non-Convex Optimization*, https://arxiv.org/abs/2407.12518, 2024.

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