

*Extending discrete gradients for unified description and analysis
of optimization methods*

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Optimization methods can correspond to continuous dynamical systems by considering the limit of zero step sizes, and in these continuous systems, convergence rates of objective functions can be derived by simple arguments. By discretizing them in various ways, we can obtain optimization methods again, but convergence analyses for these discrete systems are often complicated, requiring specific proof for each scheme. In this presentation, we consider a class of discretization by extending the discrete gradient method in structure-preserving numerical methods, and give unified convergence analyses for optimization methods belonging to this class, independent of individual schemes. This class includes existing optimization methods as well as new methods using discrete gradients. Also, since the proof is given in correspondence with the simple argument for continuous systems, this study provides a natural sufficient condition for the discretization to preserve the convergence properties of continuous systems.