

# A primal/dual computable approach to algorithmic improvement, based on dynamics

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## Abstract

Optimization problems are frequently tackled by iterative application of an operator whose fixed points allow for fast recovery of locally optimal solutions. Under light-weight assumptions, stability is equivalent to existence of a function—called a Lyapunov function—that encodes structural information about both the problem and the operator. Lyapunov functions are usually hard to find, but if a practitioner had a priori knowledge—or a reasonable guess—about one’s structure, they could equivalently tackle the problem by seeking to minimize the Lyapunov function directly. We introduce a class of methods that does this. Interestingly, for certain feasibility problems, circumcentered-reflection method (CRM) is an extant example therefrom. However, CRM may not lend itself well to primal/dual adaptation, for reasons we show. Motivated by the discovery of our new class, we experimentally demonstrate the success of one of its other members, implemented in a primal/dual framework. The presentation is principally based on the article:

*Lindstrom, Scott B. “Computable centering methods for spiraling algorithms and their duals, with motivations from the theory of Lyapunov functions.” arXiv preprint arXiv:2001.10784 (2020).*