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Performance Estimation for Fixed Point Iterations

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Resumen.
In recent years exact worst-case performance estimation of first-order methods has gained great attention: It is now well established (especially, but not solely, due to the work of de Klerk, Drori, Glineur, Hendrickx, Taylor and Teboulle) that we can find tight convergence rates for smooth (strongly) convex functions via semidefinite programming. Here we attempt to transfer the existing approach to the broader setting of fixed point iterations of non-expansive operators. Specifically we consider two fixed point iterations, first the Halpern-Iteration and second the Krasnoselski-Mann-Iteration. In both cases we focus on the convergence of the norm of the residuals as our performance criterion of interest. We are able to improve the existing bounds on the convergence rate and, more importantly, show tightness of our second bound. One notable consequence is the following: Since the gradient method with constant step-size, for the case of smooth convex functions, can be regarded as a special type of Krasnoselski-Mann Iteration we present a new and (interestingly) also tight bound for the convergence rate of the norm of the gradients. Finally we discuss applications and possible future extensions, such as different performance criteria and automated algorithm modeling.

Con el apoyo de la Facultad de Ingeniería y Ciencias, UFRO.