Linear Convergence of Accelerated Gradient without Restart

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Abstract

This is still a note for a draft so no abstract.

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1 Introduction

Notations. Unless specified, our ambient space is $\mathbb{R}^n$ with Euclidean norm $\|\cdot\|$. Let $C \subseteq \mathbb{R}^n$, $\Pi_C(\cdot)$ denotes the projection onto the set C, i.e: the closest point in C to another point in $\mathbb{R}^n$. For a function of $F = f + g$, and a $B \geq 0$ where f is $\mathcal{C}^1$ differentiable, and g is l.s.c, we consider the proximal gradient operator:

$$
\begin{aligned}
T_B(x) &= \underset{z}{\operatorname{argmin}} \left\{ g(z) + f(x) + \langle \nabla f(x), z - x\rangle + \frac{B}{2}\|x - z\|^2 \right\} \\
&= \operatorname{prox}_{B^{-1}g}(x - B^{-1}\nabla f(x)).
\end{aligned}
$$

We also define the gradient mapping operator

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2 Precursors materials for our proofs of linear convergence

{def:st-apg}

Definition 2.1 (similar triangle form of accelerated proximal gradient)

3 deriving the convergence rate

3.1 preparations

Lemma 3.1 (convergence preparations part I)

Lemma 3.2 (convergence preparations part II)

Lemma 3.3 (convergence preparations part III)

References

[1] H. H. Bauschke and P. L. Combettes, *Convex Analysis and Monotone Operator Theory in Hilbert Spaces*, CMS Books in Mathematics, Springer International Publishing, Cham, 2017.