

# FISTA restart using an automatic estimation of the growth parameter

- Jean-François Aujol (Univ. Bordeaux, Bordeaux INP, CNRS, IMB, UMR 5251, F-33400 Talence, France)
- Charles Dossal (IMT, Univ. Toulouse, INSA Toulouse, Toulouse, France)
- **Hippolyte Labarrière** (IMT, Univ. Toulouse, INSA Toulouse, Toulouse, France)
- Aude Rondepierre (IMT, Univ. Toulouse, INSA Toulouse, LAAS, Toulouse, France)

**Keywords:** FISTA, restart, convex optimization, Lojasiewicz property, convergence rate, growth parameter.

**Abstract:** In this paper, we propose a restart scheme for FISTA (Fast Iterative Shrinking-Threshold Algorithm) [1]. This method which is a generalization of Nesterov’s accelerated gradient algorithm [2] is widely used in the field of large convex optimization problems and it provides fast convergence results under a strong convexity assumption. These convergence rates can be extended for weaker hypotheses such as the Lojasiewicz property but it requires prior knowledge on the function of interest. In particular, most of the schemes providing a fast convergence for non-strongly convex functions satisfying a quadratic growth condition involve the growth parameter which is generally not known. Recent works [3, 4] show that restarting FISTA could ensure a fast convergence for this class of functions without requiring any knowledge on the growth parameter. We improve these restart schemes by providing a better asymptotical convergence rate and by requiring a lower computation cost. We present numerical results emphasizing the efficiency of this method.

## References:

- [1] A. Beck and M. Teboulle. A fast iterative shrinkage-thresholding algorithm for linear inverse problems. *SIAM journal on imaging sciences*, 2(1):183–202, 2009.
- [2] Y. Nesterov. A method of solving a convex programming problem with convergence rate  $O(1/k^2)$ . *Soviet Mathematics Doklady*, 27(2) 372-376, 1983.
- [3] T. Alamo, P. Krupa, and D. Limon. Gradient based restart FISTA. *2019 IEEE 58th Conference on Decision and Control (CDC)*, 3936–3941, 2019.
- [4] T. Alamo, P. Krupa, and D. Limon. Restart FISTA with global linear convergence. *2019 18th European Control Conference (ECC)*, 1969–1974, 2019.