ON KRYLOV METHODS FOR LARGE SCALE CBCT RECONSTRUCTION

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Krylov methods are a powerful family of iterative solvers for linear systems, which are commonly used for inverse problems due to their intrinsic regularization properties. Moreover, these methods are naturally suited to large-scale problems, as they only require matrix-vector products with the system matrix (and its adjoint) to compute approximate solutions, and they display a very fast convergence. Even if this class of methods has been widely studied, its use in applied medical physics and applied engineering is still very limited, e.g. in realistic large-scale Computed Tomography (CT) problems, and more specifically in Cone Beam CT (CBCT).

In this talk I will present our attempt to breach this gap by providing a general framework for the most relevant Krylov methods applied to 3D CT problems within an open source framework: the Tomographic Iterative GPU-based Reconstruction (TIGRE) toolbox [1].

I will show different examples in synthetic and real-world 3D CT applications (medical CBCT and µ-CT datasets), and show how Krylov subspace methods perform in this setting, including the most well-known Krylov solvers for non-square systems (CGLS, LSQR, LSMR), possibly in combination with Tikhonov regularization, and methods that incorporate total variation (TV) regularization.

References

[1] M. Sabaté Landman, A. Biguri, S. Hatamikia, R. Boardman, J. Aston and C-B. Schönlieb, *On Krylov Methods for Large Scale CBCT Reconstruction*, preprint (2022).