A projected Nesterov-Kaczmarz approach to stellar population distribution reconstruction in Extragalactic Archaeology

Fabian Hinterer[1], Prashin Jethwa[2], Simon Hubmer[3], Kirk Soodhalter[4], Glenn van de Ven[2], and Ronny Ramlau[1]

[1] Johannes Kepler University Linz, Institute for Industrial Mathematics, Linz, Austria
`{fabian.hinterer, ronny.ramlau}@jku.at`
[2] University of Vienna, Institute of Astrophysics, Vienna, Austria
`{prashin.jethwa, glenn.vandeven}@univie.ac.at`
[3] Johann Radon Institute for Computational and Applied Mathematics, Linz, Austria
`simon.hubmer@ricam.oeaw.ac.at`
[4] Trinity College, School of Mathematics, Dublin, Ireland
`ksoodha@maths.tcd.ie`

Abstract

We consider the problem of reconstructing a galaxy's stellar population distribution function from spectroscopy measurements. These quantities can be connected via the single-stellar population spectrum, resulting in a very large scale integral equation with a system structure. To solve this problem, we propose a projected Nesterov-Kaczmarz reconstruction (PNKR) method, which efficiently leverages the system structure and incorporates physical prior information such as smoothness and non-negativity constraints.

Keywords: Astrophysics, Galactic Archaeology, Inverse and Ill-Posed Problems, Kaczmarz Method, Nesterov Acceleration, Large Scale Problems