Implementation of the Sparse Modeling Method for Analytical Continuation

Tianran Chen[1,], Emanuel Gull[1]

[a] *Department of Physics, West Chester University, PA 19380, USA*
[b] *Department of Physics, University of Michigan, Ann Arbor, MI 48109, USA*

Abstract

We present SpM, a tool for performing analytic continuation of spectral functions using the maximum entropy method. The code operates on discrete imaginary axis datasets (values with uncertainties) and transforms this input to the real axis. The code works for imaginary time and Matsubara frequency data and implements the 'Legendre' representation of finite temperature Green's functions. It implements a variety of kernels, default models, and grids for continuing bosonic, fermionic, anomalous, and other data. Our implementation is licensed under GPLv3 and extensively documented. This paper shows the use of the programs in detail.

Keywords: Sparse Modeling Method, Analytic Continuation

PROGRAM SUMMARY

Manuscript Title: Implementation of the Sparse Modeling Method for Analytic Continuation
Authors: Tianran Chen and Emanuel Gull
Program Title: SpM
Journal Reference:
Catalogue identifier:
Licensing provisions: GPLv3
Programming language: C++
Operating system: Tested on Linux and Mac OS X
RAM: 10 MB – 200 MB
Keywords: Maximum Entropy Method, Analytic Continuation
Classification: 4.9
External routines/libraries: ALPSCore [**?**][**?**], GSL, HDF5
Nature of problem: The analytic continuation of imaginary axis correlation functions to real frequency/time variables is an ill-posed problem which has an infinite number of solutions.

Solution method: The sparse modeling method obtains a possible solution that maximizes entropy, enforces sum rules, and otherwise produces 'smooth' curves. Our implementation allows for input in Matsubara frequencies, imaginary time, or a Legendre expansion. It implements a range of bosonic, fermionic and generalized kernels for normal and anomalous Green's functions, self-energies, and two-particle response functions.

Running time: 10s - 2h per solution

[1] B. Bauer, et al., The ALPS project release 2.0: open source software for strongly correlated systems, J. Stat. Mech. Theor. Exp. 2011 (05) (2011) P05001. arXiv:1101.2646, doi:10.1088/1742-5468/2011/ 05/P05001.

[2] A. Gaenko, E. Gull, A. E. Antipov, L. Gamper, G. Carcassi, J. Paki, R. Levy, M. Dolfi, J. Greitemann, J.P.F. LeBlanc, Alpscore: Version 0.5.4doi: 10.5281/zenodo.50203.

1. Introduction

*Corresponding author.
E-mail address: tchen@wcupa.edu