Lattice QCD data analysis in Julia

Alessandro Conigli

IFT UAM-CSIC

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Universidad Autónoma de Madrid

Instituto de Física Teórica UAM-CSIC

ALPHA Collaboration

Motivations

- The usual workflow in Lattice QCD simulations is summarised by

Production of configurations → Measurements of primary observables → Data analysis

- In practice, we face several challenges in data analysis

Systematic uncertainties

Estimate errors from MCMC

Taking autocorrelations into account

Propagate the errors

Motivations

- These challenges are greatly simplified by the ADerrors.jl package [A. Ramos]
    - Determination of statistical uncertainties using the Γ-method
    - Automatic Differentiation (AD) techniques for error propagation
    - Error propagation in iterative algorithms

- On top of that, we present the juobs.jl package for higher-level analysis [AC, J. Ugarrio]
    - Direct computation of Lattice QCD observables
    - Implementation of the GEVP variational method
    - Advance fitting routines

Outline

1 Introduction to Julia

- Why Julia?
- Getting started
- Julia is fast!

2 The ADerrors.jl package

- The Γ-method and AD
- ADerrors.jl tutorial

3 The juobs.jl package

- Main features and Lattice QCD observables
- ADerrors.jl tutorial

Resources

Useful links

- Julia official website
- Julia free courses
- ADerrors gitlab
- Juobs gitlab

References

[1] U. Wolf, *"Monte Carlo errors with less errors"*, arXiv:0303017

[2] A. Ramos , *"Automatic differentiation for error analysis of Monte Carlo data"*, arXiv:1809.01289

[3] A. Ramos , *"Automatic differentiation for error analysis"*, arXiv:2012.11183