Solving Optimization Problems with JuMP.jl and InfiniteOpt.jl in Julia

Instructor

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Expertise: Dr. Pulsipher specializes in developing theory and tools for infinite-dimensional optimization with particular emphasis in optimal control and optimization under uncertainty. He also conducts data science research with recent work in incorporating computer vision sensors in process control systems and developing effective data-driven optimization techniques for complex engineering systems.

Course Summary

In this short course, we will address how to use InfiniteOpt.jl to model/solve a variety of infinite-dimensional optimization problems and how it enables novel formulations (e.g., using stochastic risk measures to shape dynamic cost trajectories). InfiniteOpt.jl is a Julia-based open-source software package (an extension of the popular mathematical programming modeling package JuMP.jl) that provides an intuitive symbolic interface to compactly model a wide breadth of problem classes which include dynamic, PDE-constrained, and stochastic optimization problems (and combinations thereof). Moreover, it is built modularly such that advanced users can quickly extend it to implement their cutting-edge modeling/solution techniques to make them accessible to a wide audience of individuals with a limited technical background. All these aspects make InfiniteOpt.jl a powerful tool for both practitioners and advanced researchers alike in tackling advanced optimal control problems.

This hands-on short course will begin with practical introductions to using Julia and JuMP.jl. With this new skillset, we will then explore the ins and outs of using InfiniteOpt.jl.

Learning Outcomes

Attendees of this course will learn how to:

- Setup basic scripts in Julia
- Model and solve traditional optimization problems in JuMP.jl
- Model and solve optimal control problems in InfiniteOpt.jl
- Exploit InfiniteOpt.jl as a sandbox for research and development.

Intended Audience

Graduate students, researchers, and industry practitioners interested in tools for infinite-dimensional optimization problems (i.e., problems involving time, space-time, and/or uncertainty). Some familiarity with mathematical optimization is recommended, but not required.

Required Materials

- Personal laptop (Windows or MacOS is recommended)
- A positive learning mindset

Schedule

Times	Topic	Duration
9:00 a.m. – 9:30 a.m.	*Introduction* - The why and what of Julia, JuMP.jl, and InfiniteOpt.jl.	30 min.
9:30 a.m. – 10:00 a.m.	*Installation and Setup* - Configure software on personal laptop. Online interface provided as an alternative.	30 min.
10:00 a.m. – 10:10 a.m.	Break	10 min.
10:10 a.m. – 11:10 a.m.	*Julia: A Practical Introduction* – Overview of core types, programmatic syntax, and package management.	60 min.
11:10 a.m. – 11:20 a.m.	Break	10 min.
11:20 a.m. – 12:00 p.m.	*JuMP.jl: A Brief Introduction* – The basics of modeling and solving mathematical optimization problems in JuMP.jl.	40 min.
12:00 p.m. – 1:00 p.m.	Lunch	60 min.
1:00 p.m. – 2:00 p.m.	*JuMP.jl: Beyond the Basics* – A deeper dive into the core modeling/solution strategies including variables, constraints, containers, and more.	60 min.
2:00 p.m. – 2:10 p.m.	Break	10 min.
2:10 p.m. – 3:20 p.m.	*InfiniteOpt.jl: The Basics* – An introduction on how to compactly model and solve complex infinite-dimensional optimization problems.	70 min.
3:20 p.m. – 3:30 p.m.	Break	10 min.
3:30 p.m. – 4:15 p.m.	*InfiniteOpt.jl: New Modeling Strategies* – A tutorial on how InfiniteOpt.jl enables new formulation/solution approaches.	45 min.
4:15 p.m. – 4:45 p.m.	*InfiniteOpt.jl: Deployment Tools* – An overview of the API to enable rapid deployment of new modeling/solution techniques.	30 min.
4:45 p.m. – 5:00 p.m.	*Final Thoughts* – Summary of key points and panned future development. Provide resources for further learning.	15 min.