Exploring Low-Order Aerodynamic Models using Julia

SoCal Julia π-day Meetup

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The Problem

We want to find the force on a wing undergoing some prescribed motion.
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We want to find the force on a wing undergoing some prescribed motion

Common Reactions

“Wait… are you serious? We don’t know that?”

or

“Easy, just toss it at some CFD software!”
For control purposes, high fidelity CFD is computationally expensive.

**Reduced-Order Modeling**

Diagram showing the flow of information from Desired Force to Controller, then to Prescribed Kinematics, and back to Reduced-Order Model.
For control purposes, high fidelity CFD is computationally expensive.

Reduced-Order Modeling

Flapping rate between 50 to 200 times per second
Mathematical Reduced-Order Modeling

Physics-Based Reduced-Order Modeling
Physics-Based Reduced-Order Modeling

Physics-Based Reduced-Order Modeling

Desired Force → Controller → Prescribed Kinematics

Controller ↷ Predicted Force

Low Order Vortex Model → Prescribed Kinematics
Why Julia?

Keeping in mind that most ideas will end up failing

• Faster transition between pen/paper to code
• Un-vectorized code can be fast
• Modification and borrowing code from libraries
• Unicode identifiers!

Makes it much faster to discover and reject bad ideas!