COMPUTATIONALLY EFFICIENT CONTROL CO-DESIGN OPTIMIZATION FRAMEWORK WITH MIXED-FIDELITY FLUID AND STRUCTURE ANALYSIS

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SUMMARY

- *Computationally efficient control co-design optimization framework.*
- *Representative and accurate reduced-order models are derived from high-fidelity CFD and CSM tools.*
- *Modular and open-source for integration with other codes.*
- *Includes standard and real-world load cases & libraries.*
- *Ability to import, export and link with standard software such as MatLab, Simulink, Python scripting/API, Excel, etc.*

MULTIDISCIPLINARY TEAM

Rutgers University:
- *Onur Bilgen (PI)*
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University of Michigan:
- *Joaquim R. R. A. Martins (co-PI)*

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National Renewable Energy Laboratory:
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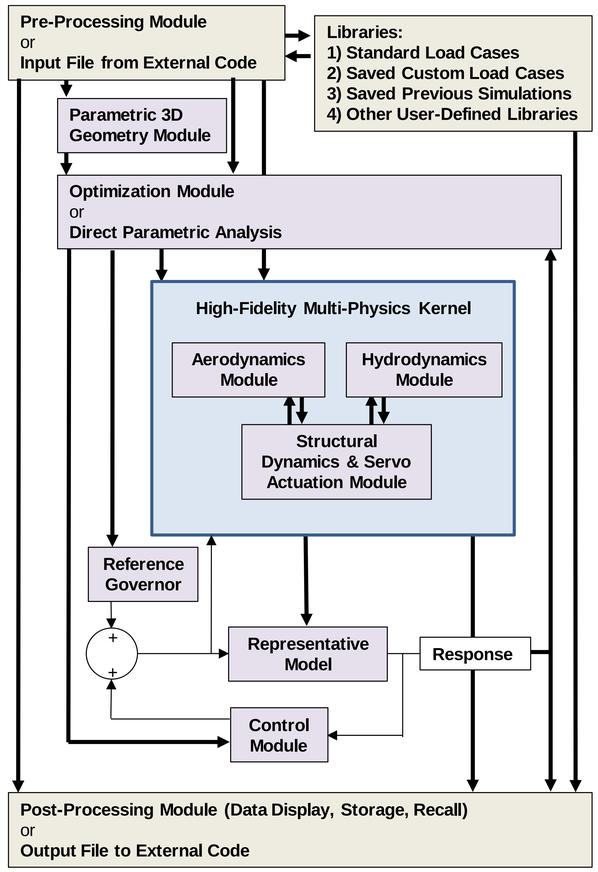
Collaborators - Rutgers:
- *Travis Miles, Ruo-Qian Wang*

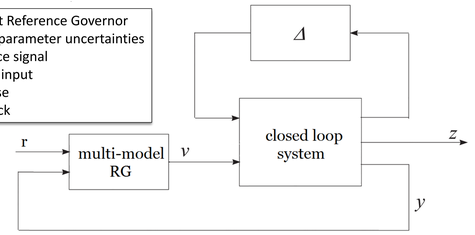
Unfunded Collaborators:
- *Frederik Zahle (Tech. U. of Denmark)*
- *Erin Bachynski (NTNU)*

COMPUTATIONAL DESIGN OPTIMIZATION FRAMEWORK

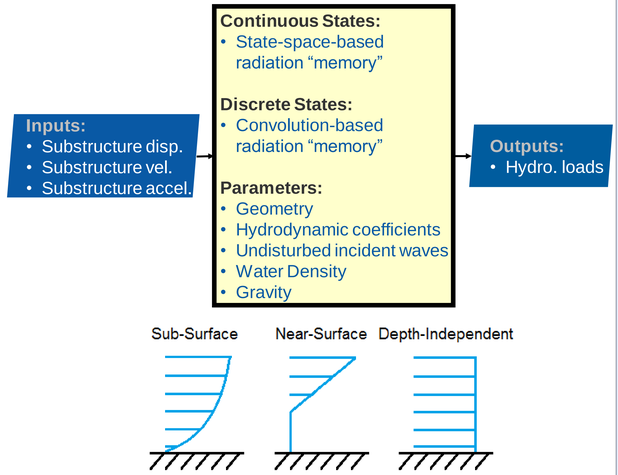


CONTROL METHOD

RG: robust Reference Governor
Δ: model parameter uncertainties
r: reference signal
v: control input
z: response
y: feedback

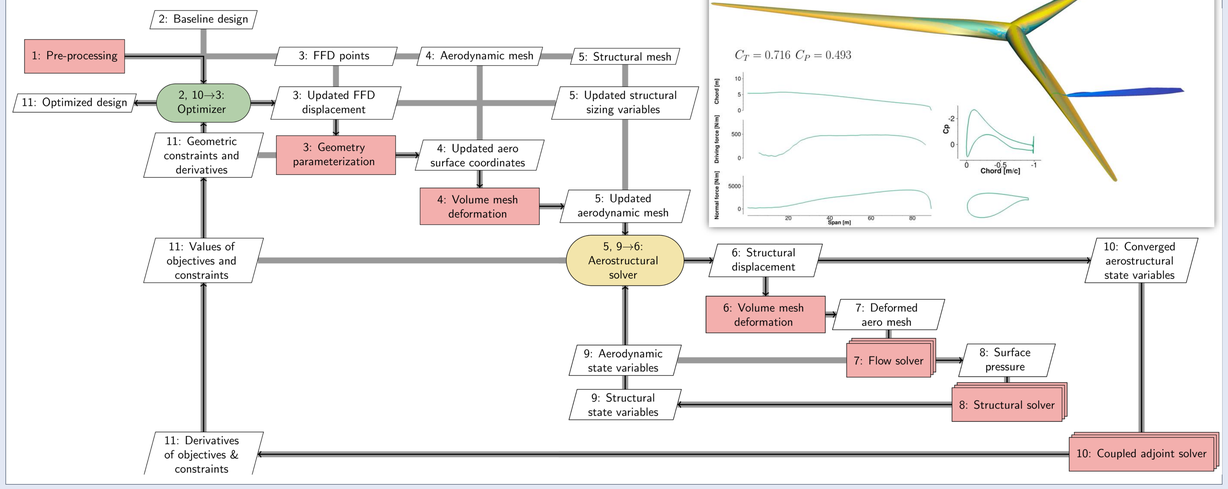


HYDRODYNAMICS: *HydroDyn*



AERO-STRUCTURAL OPTIMIZATION

University of Michigan's MACH Framework



IMPACT

- *Integration of traditional aeroelastic models with higher-fidelity simulation tools including unsteady Reynolds-averaged Navier-Stokes (RANS) solvers, and 3D structural finite-element solvers.*
- *High-fidelity tools provide numerically exact gradients to facilitate both efficient optimization and local linearization for control system development.*

RESEARCH TASKS

		'20 Q1	Q2	Q3	Q4	'21 Q5	Q6	Q7	Q8
T1	**TASK 1**								
T1.b	Framework with Placeholder Modules	■	■						
T2	**TASK 2**								
T2.a-e	Uncoupled Modules	■	■						
T3	**TASK 3**								
T3.a-e	Coupled Modules			■	■	■			
T4	**TASK 4**								
T4.a	Assembly of Alpha Version				■	■			
T4.c	Alpha Version Testing and Corrections						■	■	
T4.d	Assembly of Beta Version								■
T5	**TASK 5**								
T5.a	Technology-to-Market (T2M) Plan	■	■	■	■	■	■	■	■
T6	**TASK 6**								
T6.a,b	CCT-9 with NREL FOCAL	■	■	■	■	■	■	■	■

ACKNOWLEDGMENTS

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