

# CENTER FOR POWER OPTIMIZATION OF ELECTRO-THERMAL SYSTEMS

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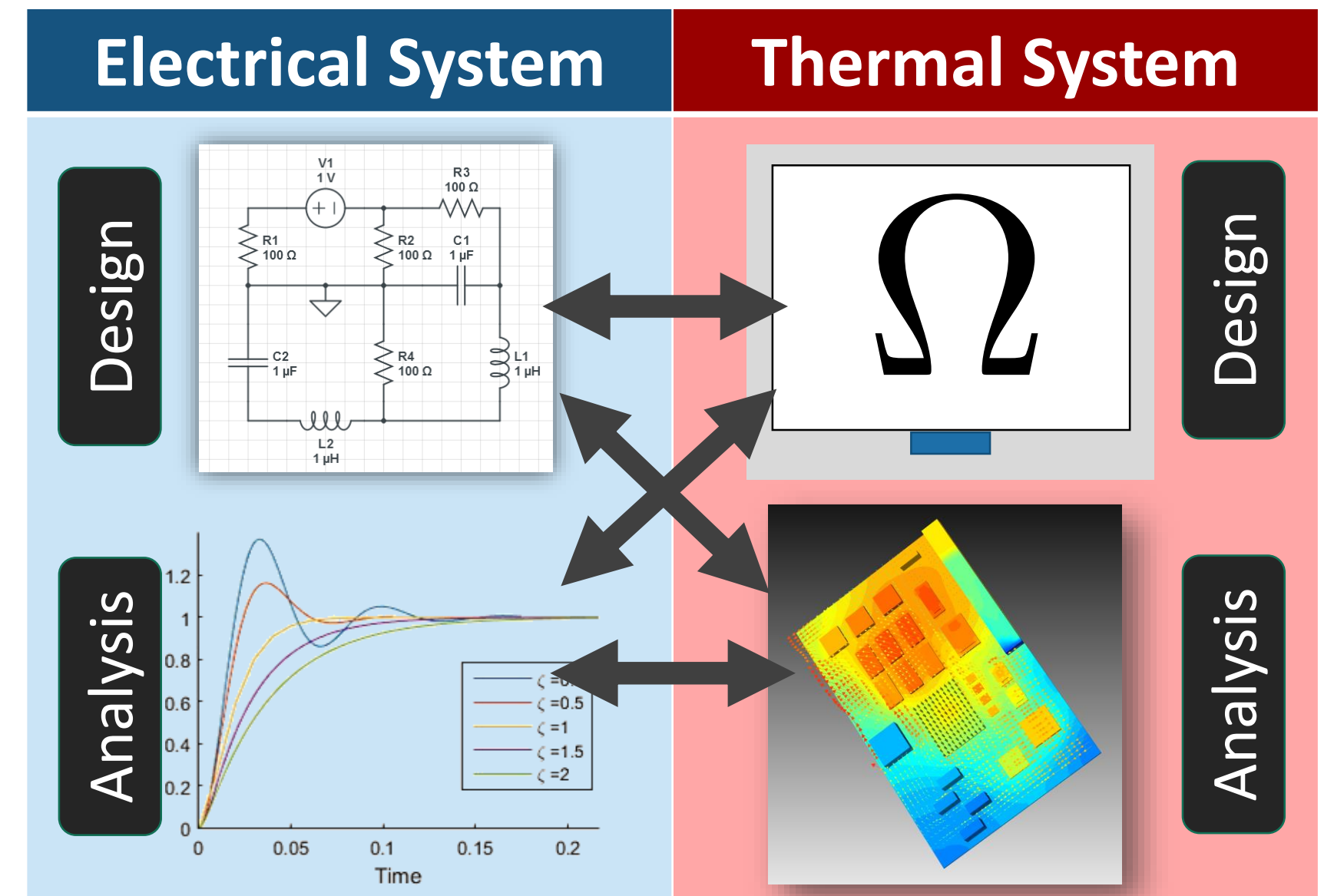


## Integrated Design Methods for Electro-Thermal Power Systems

Daniel R. Herber (UIUC), Danny J. Lohan (UIUC), Dr. James T. Allison (UIUC),  
Masanori Ishigaki (Toyota), Ercan M. Dede (Toyota)

How can we better integrate design activities across multiple disciplines (electrical, thermal, control systems) and scales (device, component, system levels)?

- Highly coupled systems
- Maintain the advances made in each domain
- Qualitative and quantitative insights

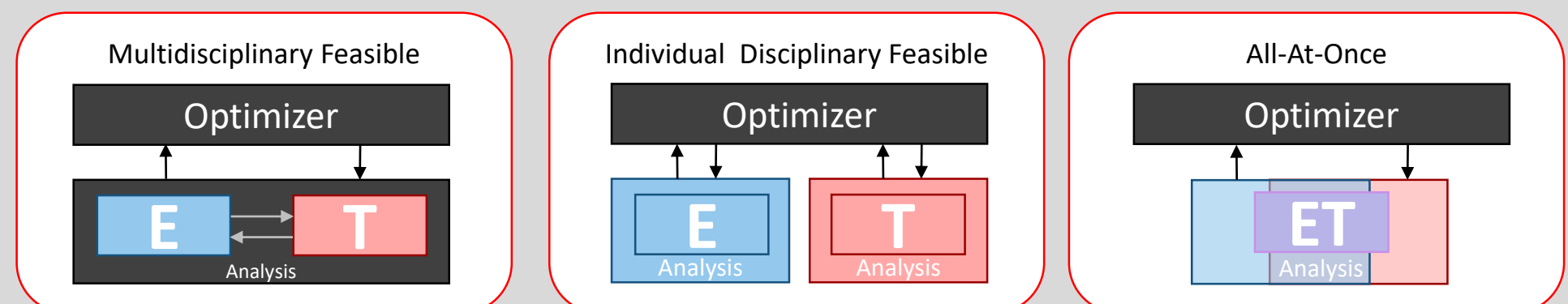


**Vision:** Develop new design strategies and leverage existing ones that allow for optimal integrated design of power dense systems.

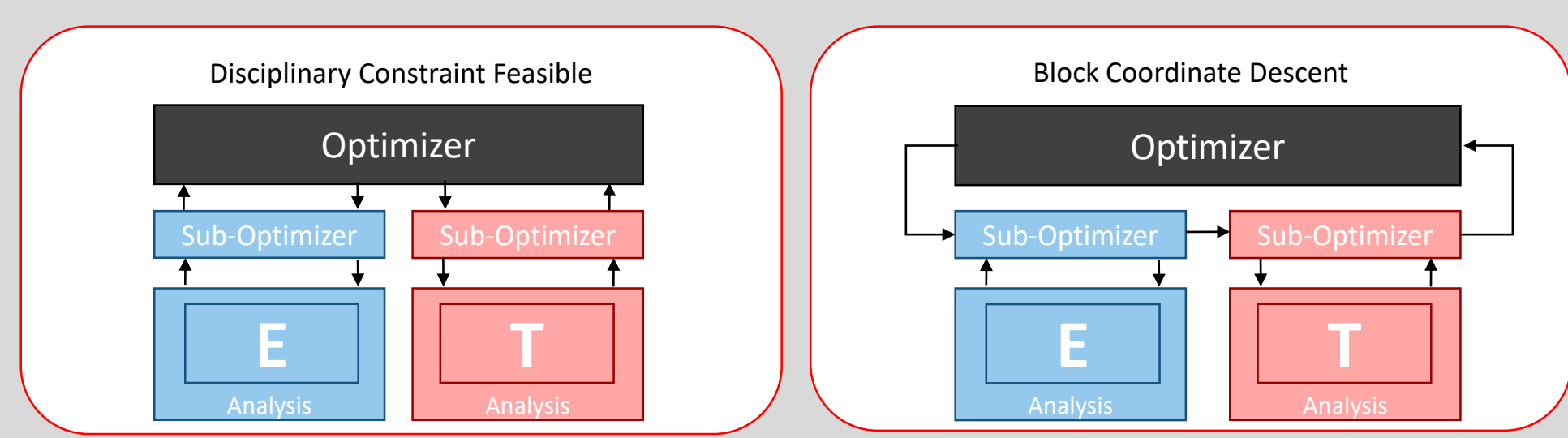
### Methodology and Approaches

#### MDO Coordination Strategies

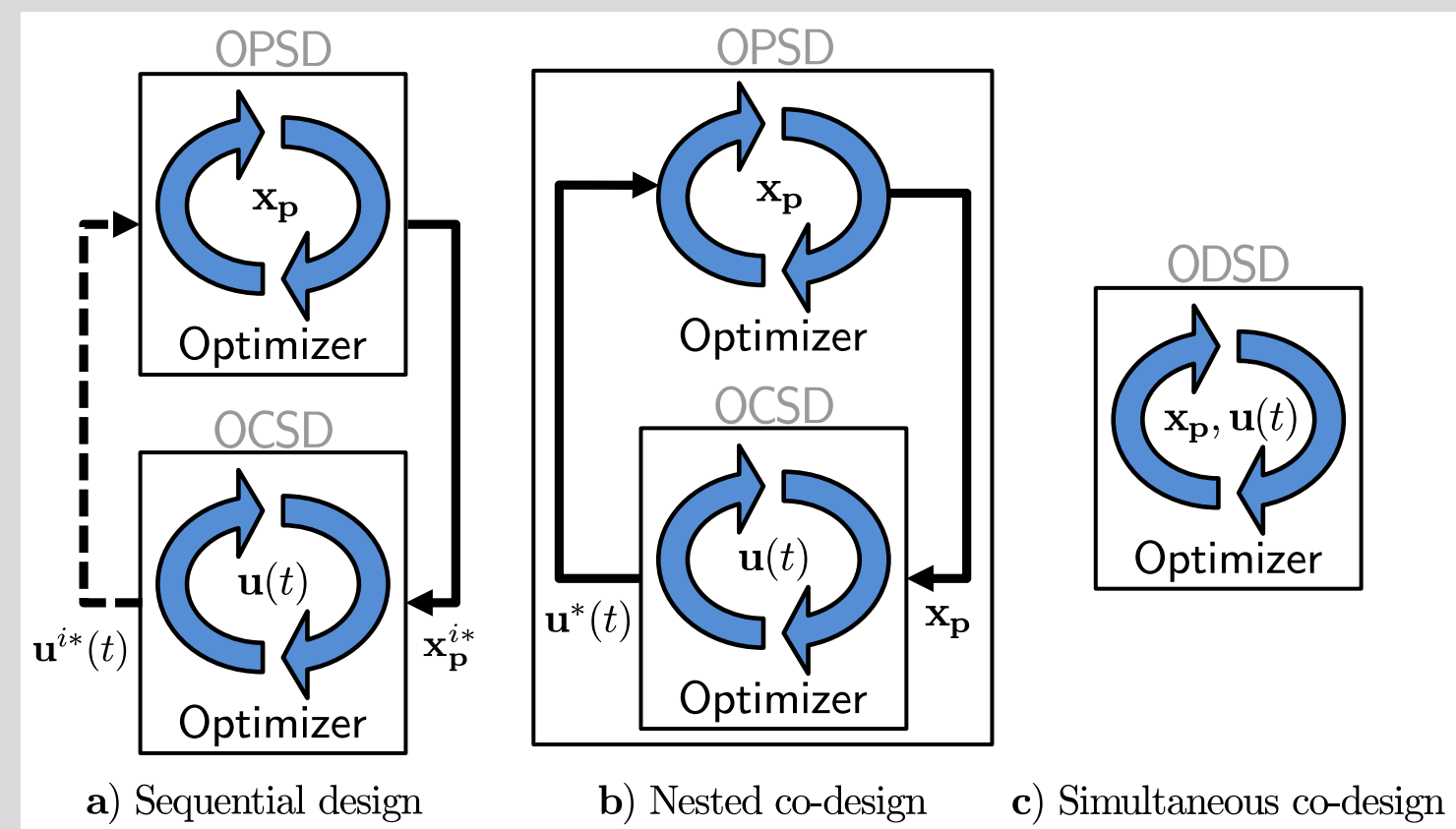
##### Single Level Formulations



##### Multi-level Formulations



### Co-Design Strategies

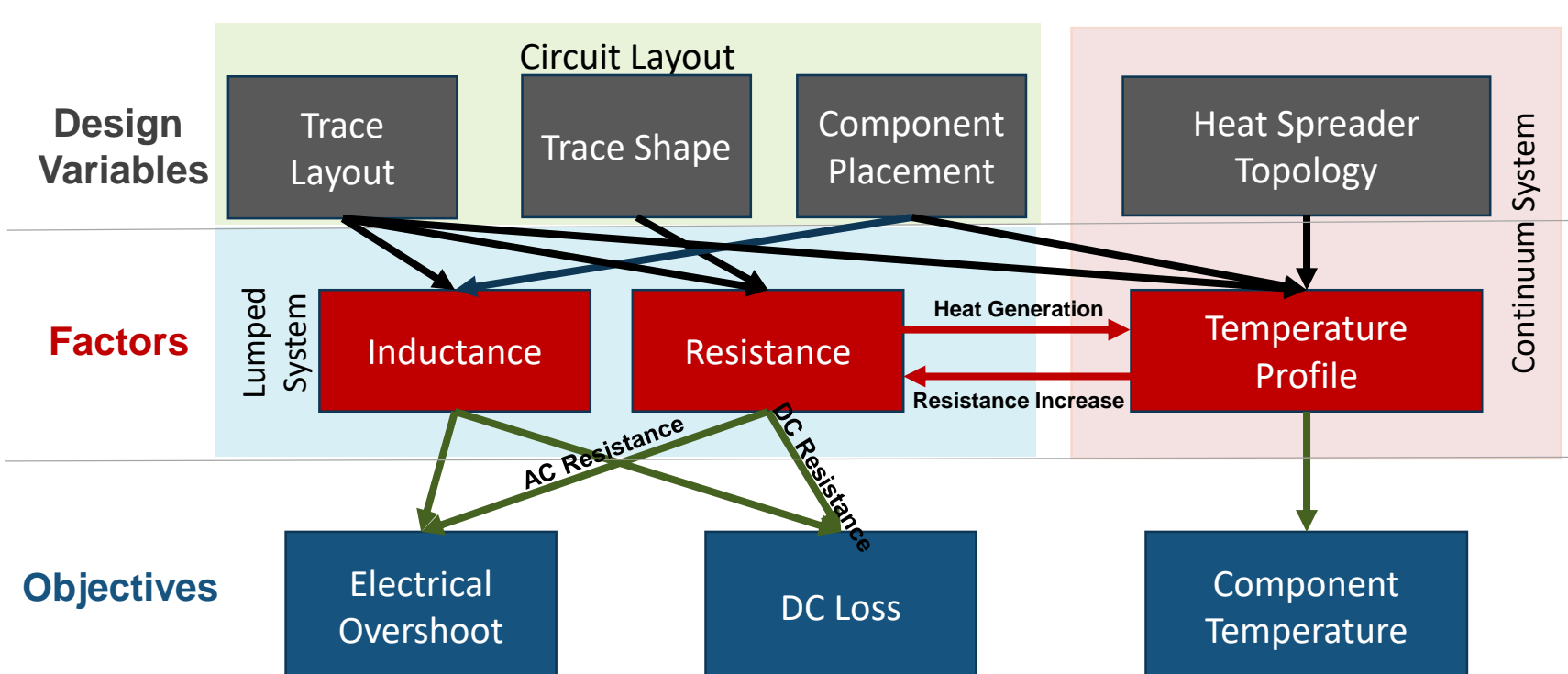


### Linking Online and Offline Optimization

Link **open-loop co-design** (offline optimization) results with **implementable digital feedback control system** (online optimization)



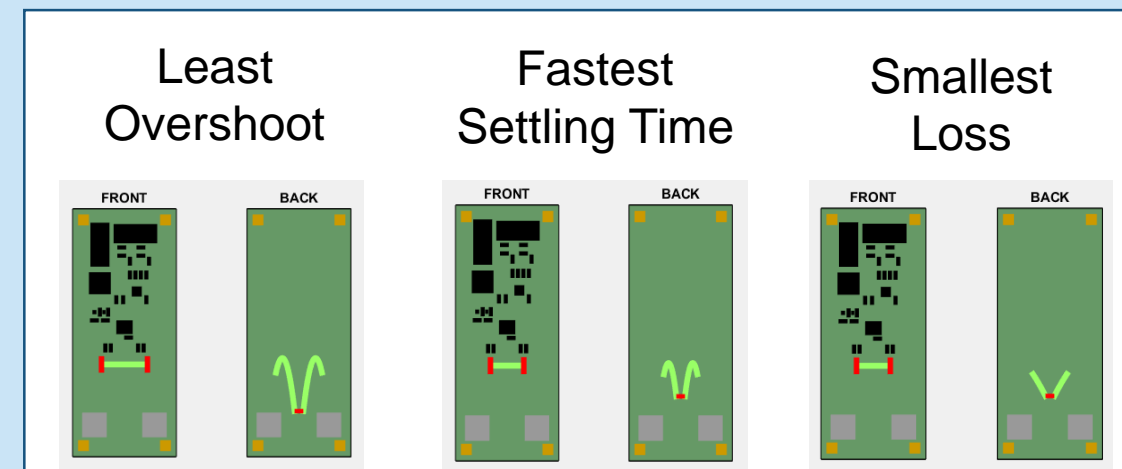
### Main Results



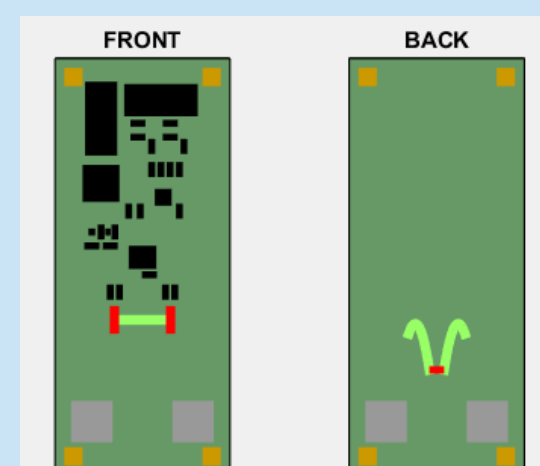
### Optimization Results

#### Electrical System

The best performing designs are presented below.



#### Best Overall Design



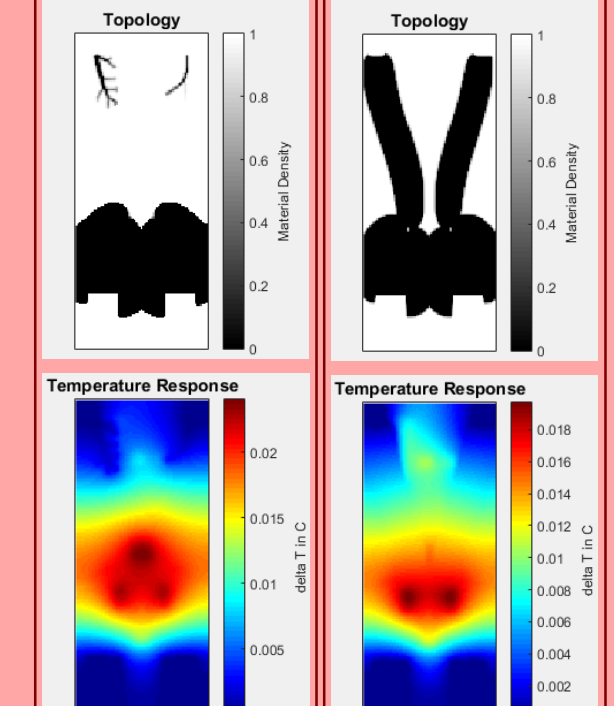
The best overall design results in a critically damped system with the best possible settling time and loss characteristics.

#### Thermal System

The optimal heat spreader topology

Volume of Spreader

30% 50%



#### Conclusion

Combining separate designs results in a multi-layer PCB. Future work looks to further integrate design strategies to enable the design of more efficient power electronics.

#### Acknowledgements

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