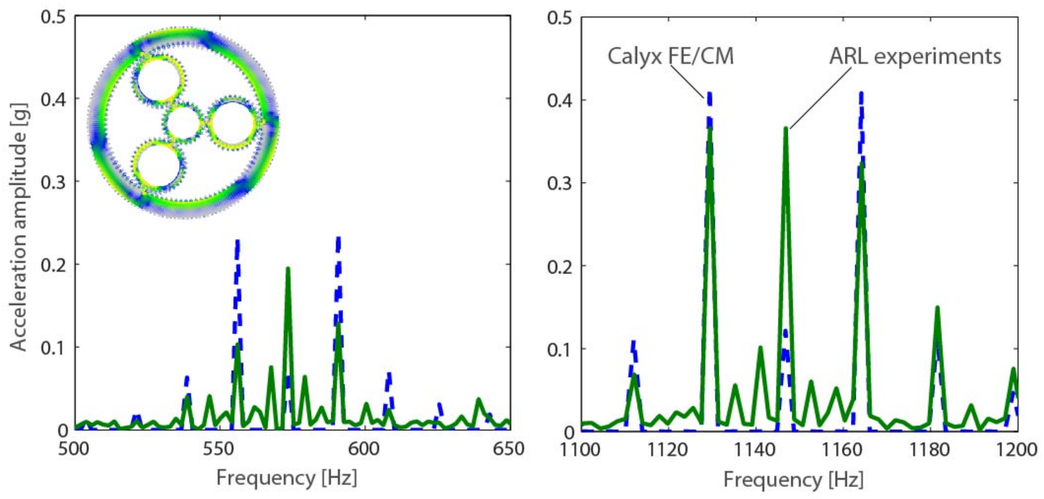
Durable and Active Power Transmissions

S&T Campaign: Sciences for Maneuver
Energy and Propulsion
Distribution and Transfer

Adrian Hood, Ph.D., (410) 278-9581, adrian.a.hood.civ@mail.mil
Mark Valco, Ph.D., (216) 433-3717, mark.j.Valco.civ@mail.mil
Waldo Acosta, (216) 433-3393, waldo.a.acosta.civ@mail.mil
Brian Dykas, Ph.D., P.E., (410) 278-9545, brian.d.dykas.civ@mail.mil

Research Objective

Advance the state of the art in dynamics, diagnostics and modeling of complex, flexible, and variable-ratio power transmissions for propulsion of high speed vertical flight aircraft



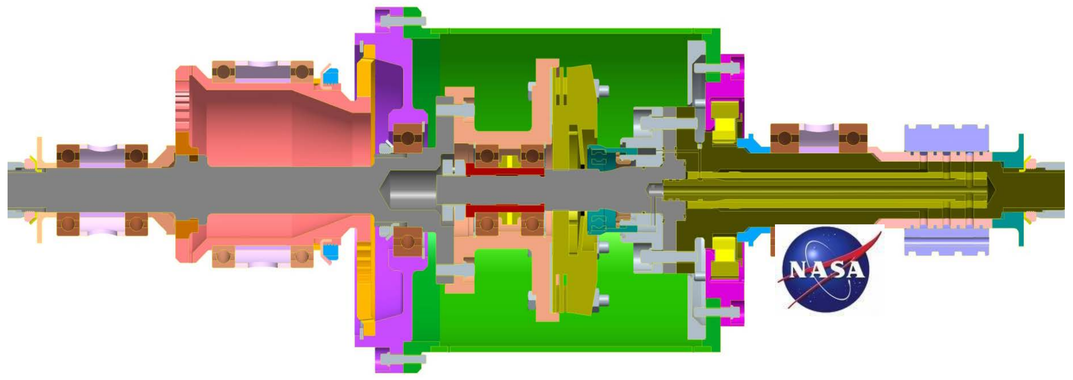
Comparison of data with predictions from hybrid finite element/contact analysis models

ARL Facilities and Capabilities Available to Support Collaborative Research

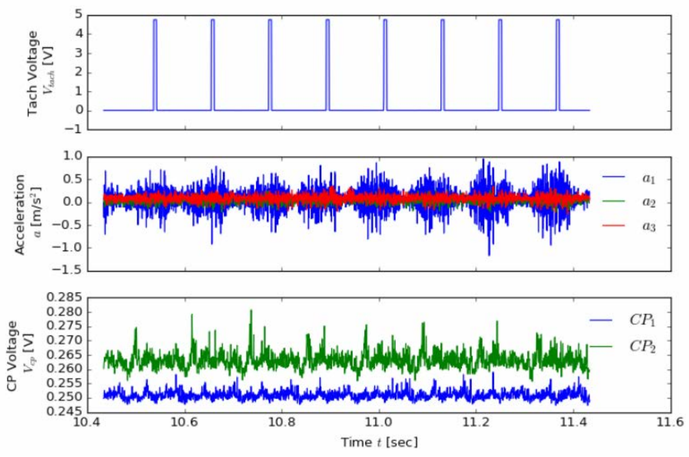
- Drives System Research Lab
  - Multi-input 1000 -2000 hp scale transmissions
- Higher Performance Mechanical Component Lab
- Tribology laboratory
  - WAM14 ball-on-disc tribometer
  - CETR UMT-3 tribometer
- Rotorcraft Propulsion Laboratories (ARL Extended)
  - Gear test rigs (incl. spiral bevel, spur, face, and helical)
  - Single gear tooth bending rigs
  - 500-hp helicopter transmission test rig
  - Variable speed aircraft transmission rig
  - Composite shaft test rig
  - Gear windage rig

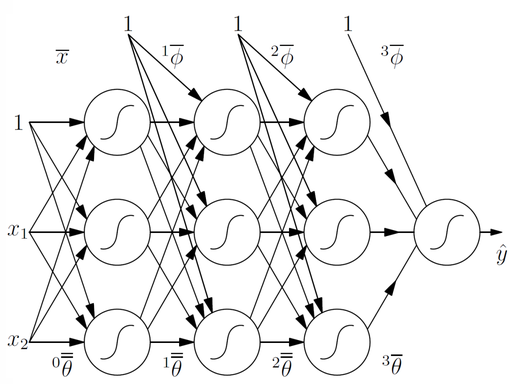
Challenges

- Developing highly accurate finite element/contact models capable of capturing dynamic response of complex and multispeed transmissions
- Quantifying uncertainty for probabilistic analysis
- Characterizing performance of machine learning techniques to discern early damage from highly variable operating conditions
- Sensor technologies with high sensitivity to driveline component damage



Two-speed, rotorcraft transmission concept





Exploring different deep architectures with greedy, layer-wise learning

Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- Modeling of highly stressed multibody mechanical systems for power transfer in complex configurations
- Expertise in helicopter drivelines including dynamics of epicyclic gears
- Acoustic emission diagnostics in rotating dynamic systems
- Modeling and simulation of damage progression and failure prediction
- Expertise in probabilistic life estimation
- Expertise and experimental facilities for research in variable speed transmissions for high-power aerospace applications
- Knowledge and expertise in clutches and mechanical interlocks for high torque applications with minimal wear and debris generation

Application of representation learning to difficult-to-detect damage modalities