

# Model Based Fault Detection and Diagnosis (FDD) In Electro- Hydraulic Actuator (EHA)

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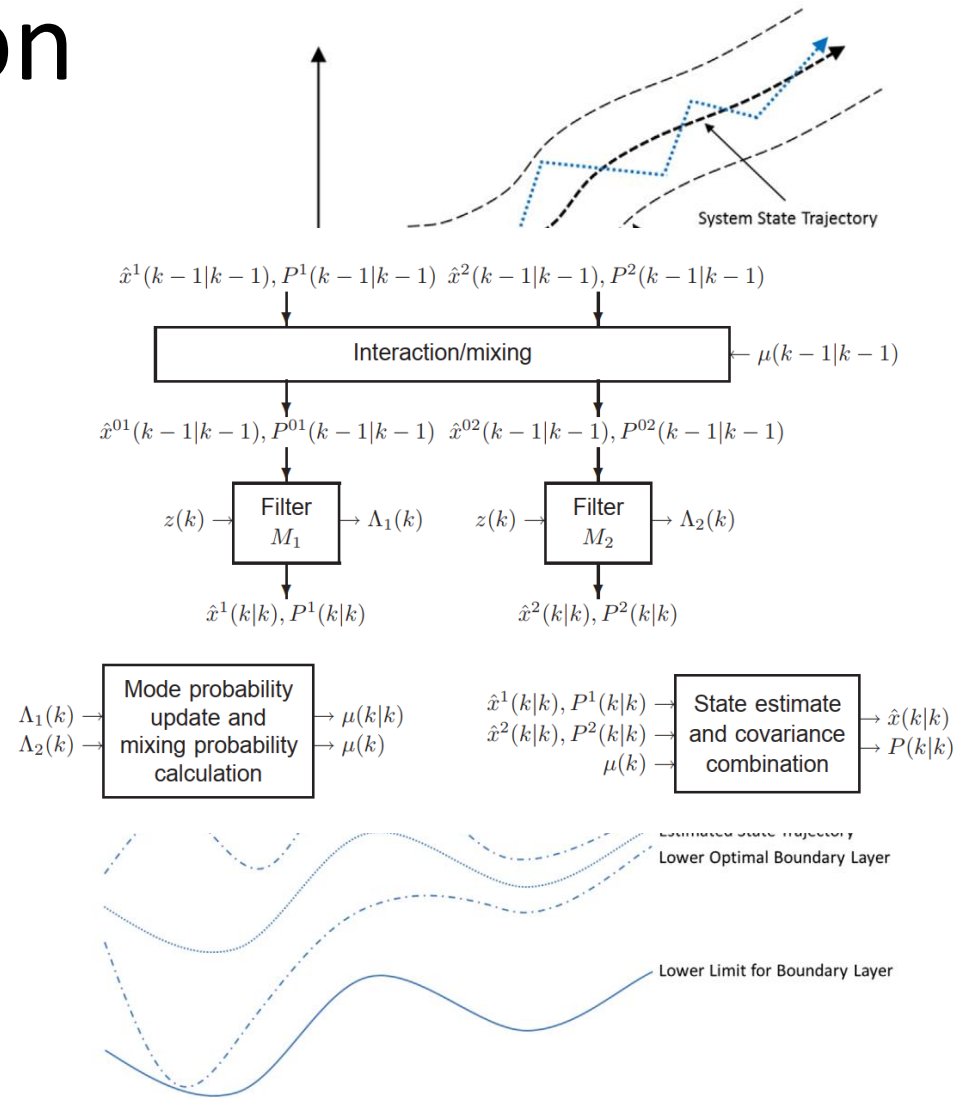
**Level of studies:** PhD

**Presentation Date:**30/04/2020

# Project Description

- Why Fault detection in EHA?
  - Vast application
  - Harsh environment
  - Safety Issue
- Model-Based FDD
  - Kalman Filter
    - MMSE:  $\hat{x}(k|k) \triangleq E[x(k)|Z^k]$
    - Additive White Noise
    - Filter gain obtained in a separate loop
  - SVSF
    - Robust
  - Fixed Boundary Layer  $\psi$  (FBL)
  - Variable Boundary Layer  $\psi$  (VBL)
 
$$\frac{\partial(\text{trace}[P(k+1|k+1)])}{\partial \psi} = 0$$

$$\rightarrow \psi \propto e_z(k|k)$$
- IMM

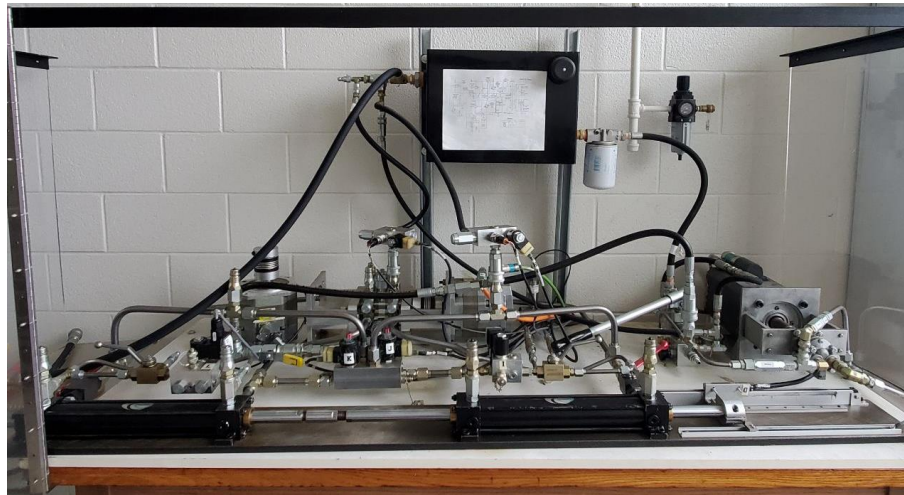


# Objective(s)

- Providing a robust model based FDD approach for a dual-redundancy EHA using IMM-SVSF
- Concentration on further improving the performance by developing other FDD approaches for the system
- Suggestion to make the system fault tolerant.

# Tasks/Plan

- To upgrade EHA setup.
  - Consider access to introduce the faults
  - Consider sensors for fault diagnosis
- Providing a comprehensive model for EHA
- Designing IMM-SVSF and alternative FDD approaches
- Applying the designed model based fault detection on EHA test rig.



# Progress Report

- Literature review on FDD in electro-hydraulic system.
- Studying the field of state and parameter estimation, with more focus on SVSF, KF and IMM.
- Models has been provided for EHA system, leakage fault and friction fault.
- An EKF has been designed to estimate system states as well as effective bulk modulus
- starting the process of upgrading the EHA test rig.
  - The new NI cDAQ has been purchased.
  - Two Infranor servo motors has been ordered to replace the out dated Siemens motors

Dynamic Multiple Filter estimation For Major Leakage Model

