

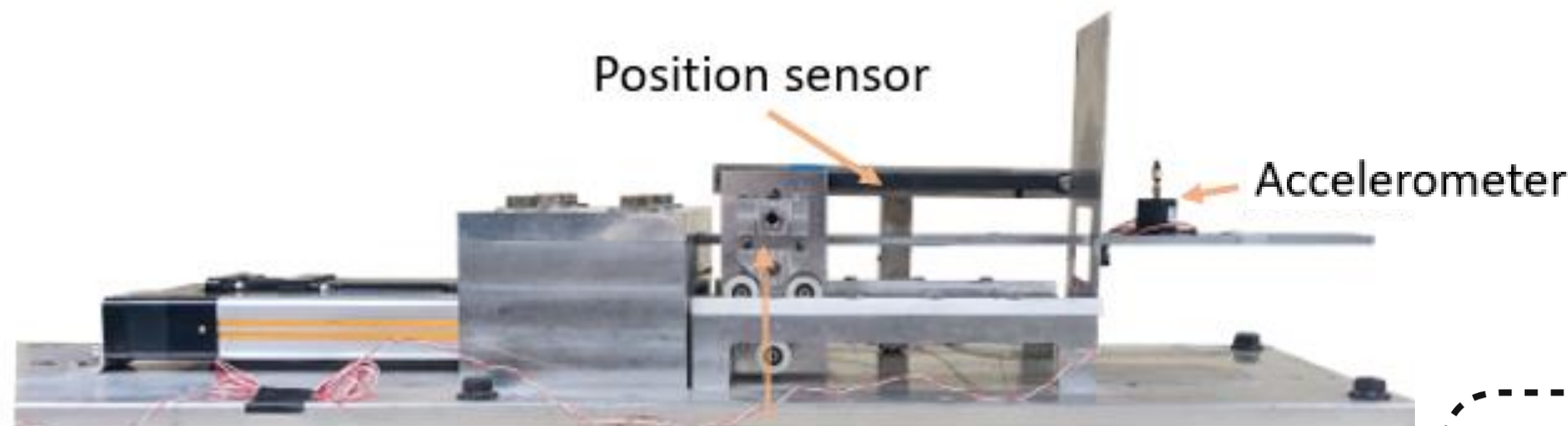
# Physics-based Real-time Model Updating for Structures in High-rate Dynamic Environments

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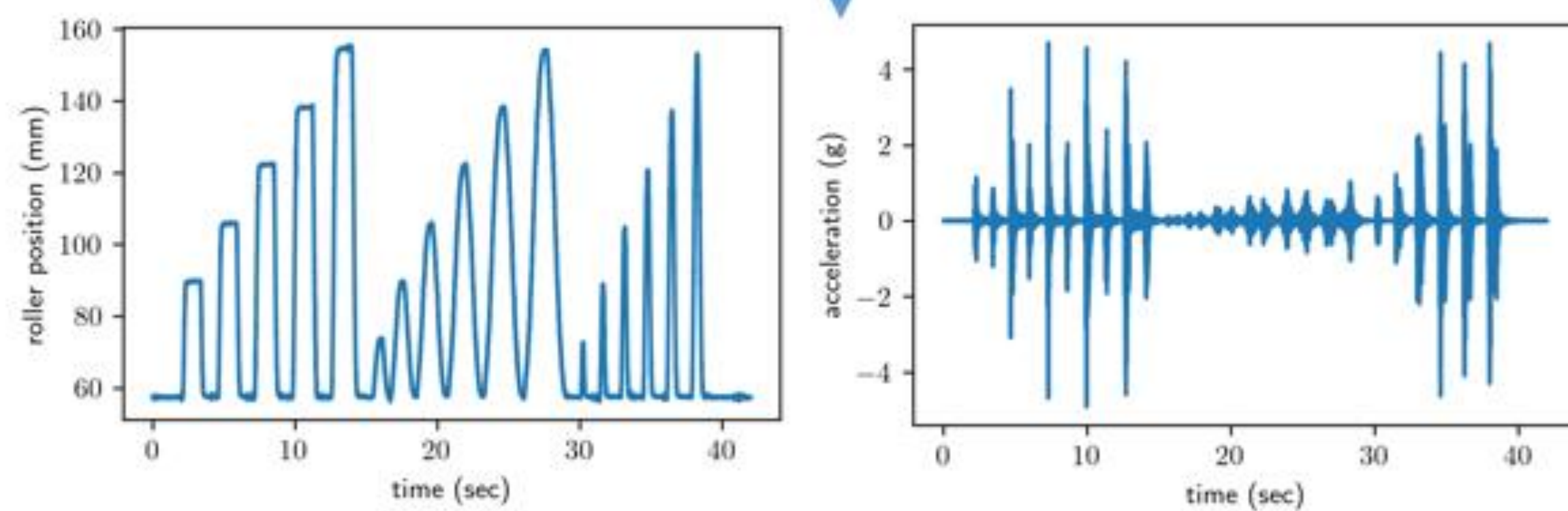
## Introduction

- The effective reactions to be taken in real-time requires an up-to-date model of the structure's state.
- The short timescale of relevance to these structures means that the model must be continuously updated with a time step of 1 ms or less.

## DROPBEAR Testbed



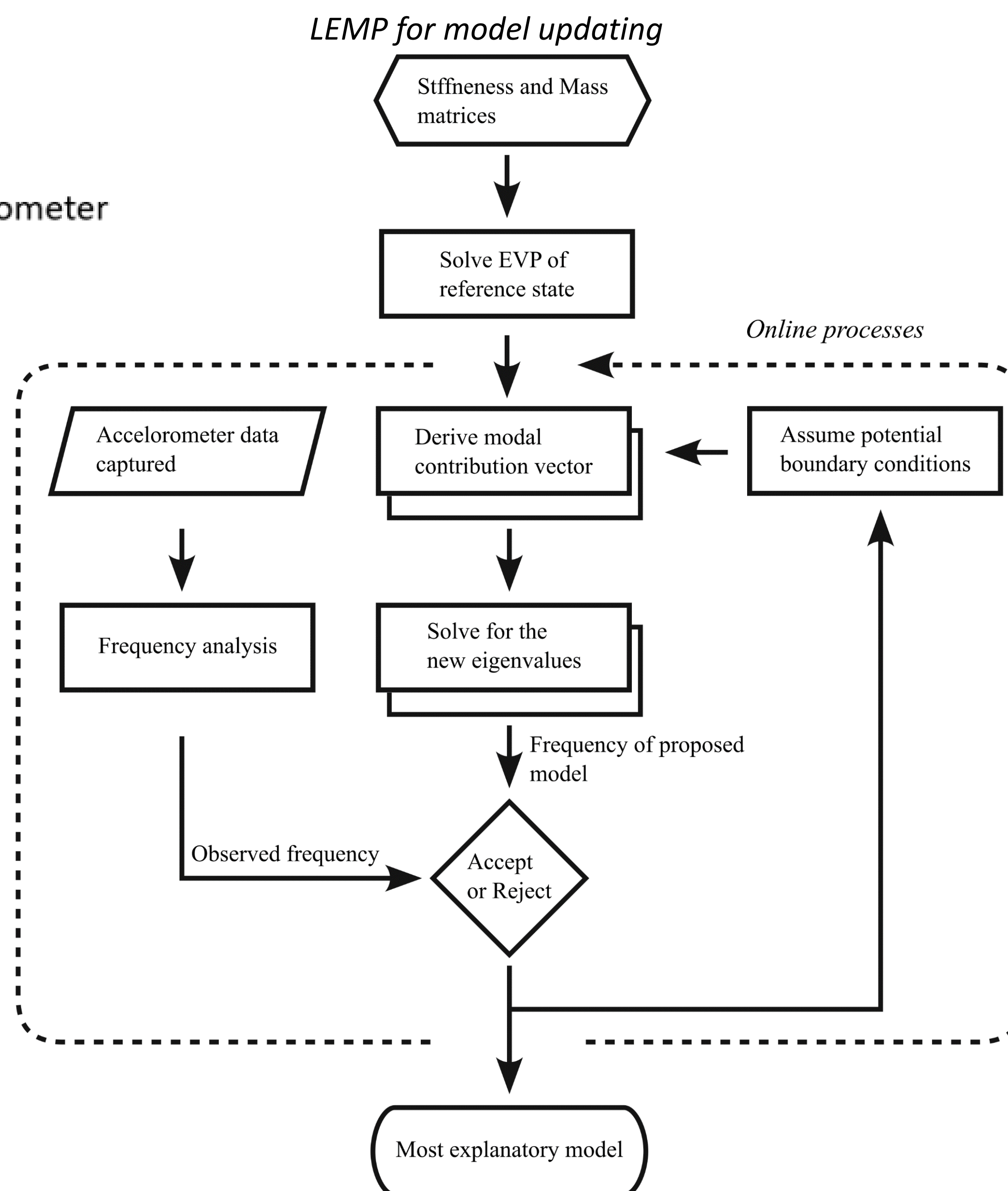
### Rolling pinned condition



- The testbed allows for the controlled movement of a pinned condition attached to an otherwise free cantilever beam.
- It can be modeled as a 1-D Finite Element formulation and can instate a repeatable change to its boundary condition.

## Innovation

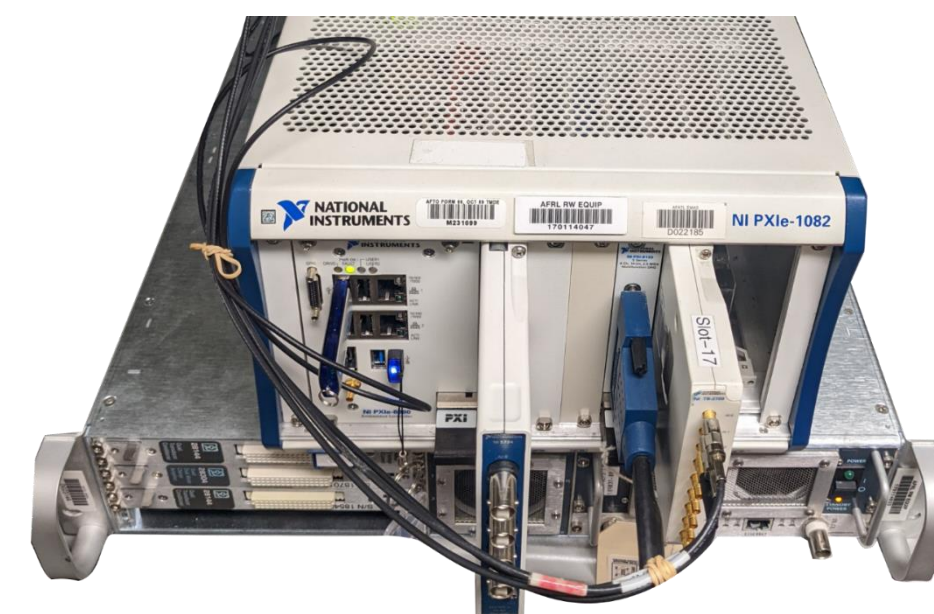
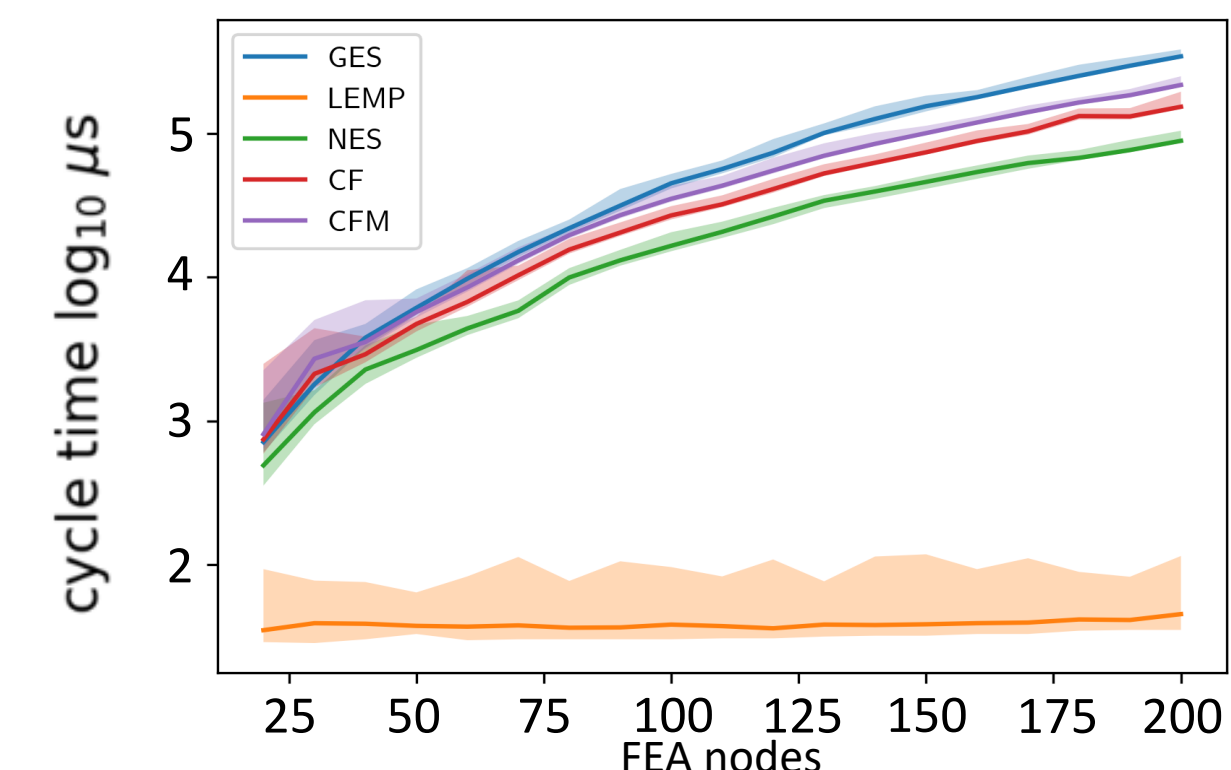
- In high-rate state model updating by modal analysis, there is a requirement to retrieve the eigenvalues of a proposed model.
- The Local Eigenvalue Modification Procedure (LEMP) bypasses the eigen value problem solving for a modified state from a reference state.



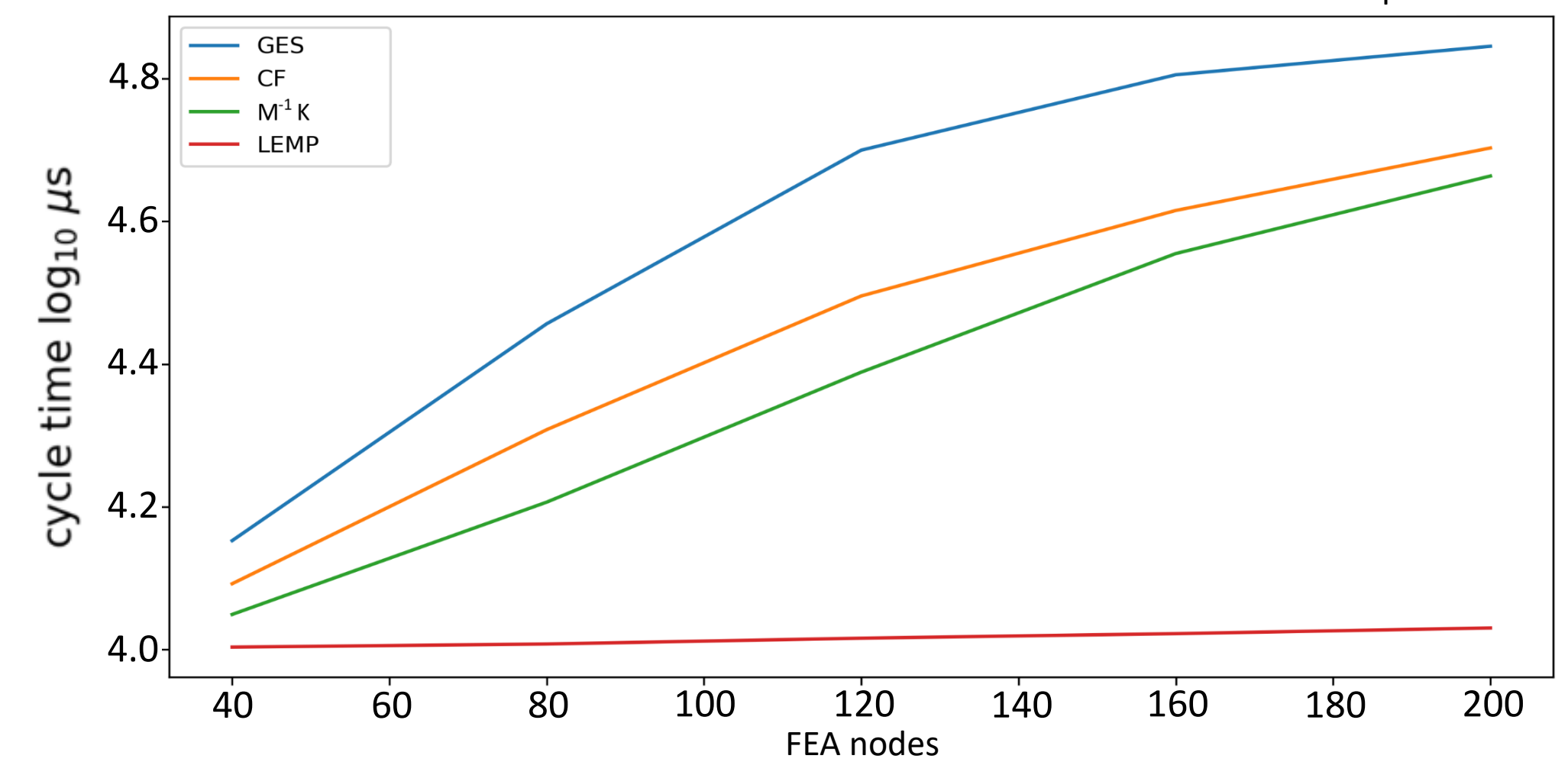
## Results

- The LEMP algorithm has allowed a greater than a hundred-fold reduction in model update time surpassing the 1 ms time target and reaching max 900  $\mu$ s model update time on the live hardware implementation.

Time of execution for EVP solvers VS LEMP FEA simulation step



Time of execution for EVP solvers VS LEMP with hardware in the loop



LEMP position estimate with hardware in the loop

