



# Performance Assessment based on Health Baseline and MML for Hydraulic



Fourth European Conference of Prognostics and Health Management Society  
3-6 July 2018, Utrecht, The Netherlands

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## Research Objective

**Performance degradation assessment based on health baseline and metric learning is proposed.**

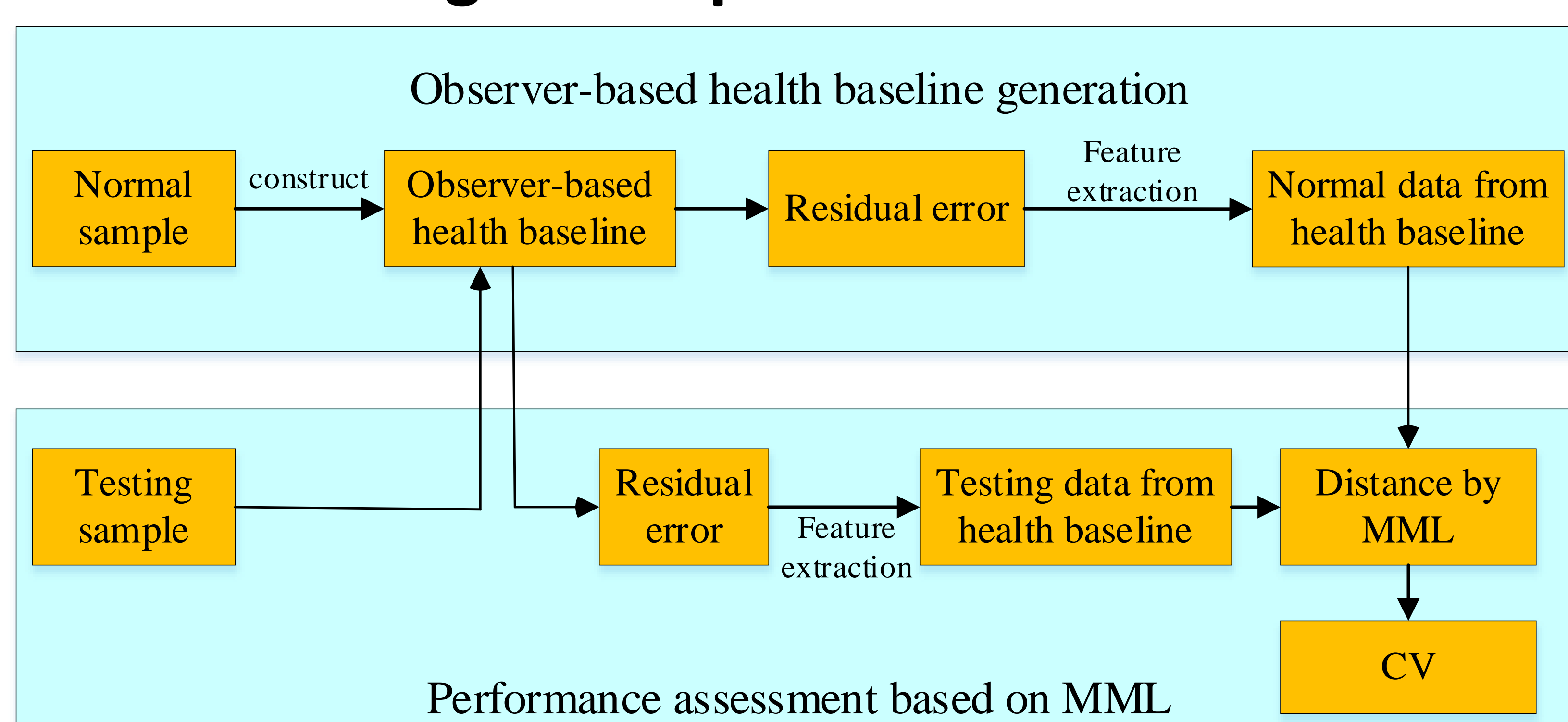
Failure and degradation of hydraulic system are harmful, leading to the economic loss or catastrophic accidents. Therefore, accurate and efficient performance assessment is essential for hydraulic system to provide condition based maintenance.

## Expected Contributions

- MML is proposed to assess the distance or similarity between the normal testing system.
- Health baseline based on state-observer is defined to express the health status of hydraulic system.
- CV normalized from distance is the ultima index for the performance of hydraulic system.
- Methodology is validated by the simulation data and results show the effectiveness.
- Method is universal for various hydraulic system because only input and output monitoring data are requisite.

## Research Details

### Schematic diagram of performance assessment



### Simulation model and fault injection

- General simulation model in joint environment. Mechanical and hydraulic parts in HyPneu. Control parts in Simulink.
- Electronic amplifier gradual fault were injected by modifying relevant parameters.

### Acknowledgments and References

This research was supported by the National Natural Science Foundation of China [Grant Nos. 51605014, 51105019 and 51575021], the Aviation Science Fund [Grant No. 20163351018], the Technology Foundation Program of National Defense [Grant No. Z132013B002], and the Fundamental Research Funds for the Central Universities [Grant No. YWF-18-BJ-Y-159].

## State of Research

Presents a performance assessment method based on the health baseline and Mahalanobis metric learning (MML) for hydraulic system.

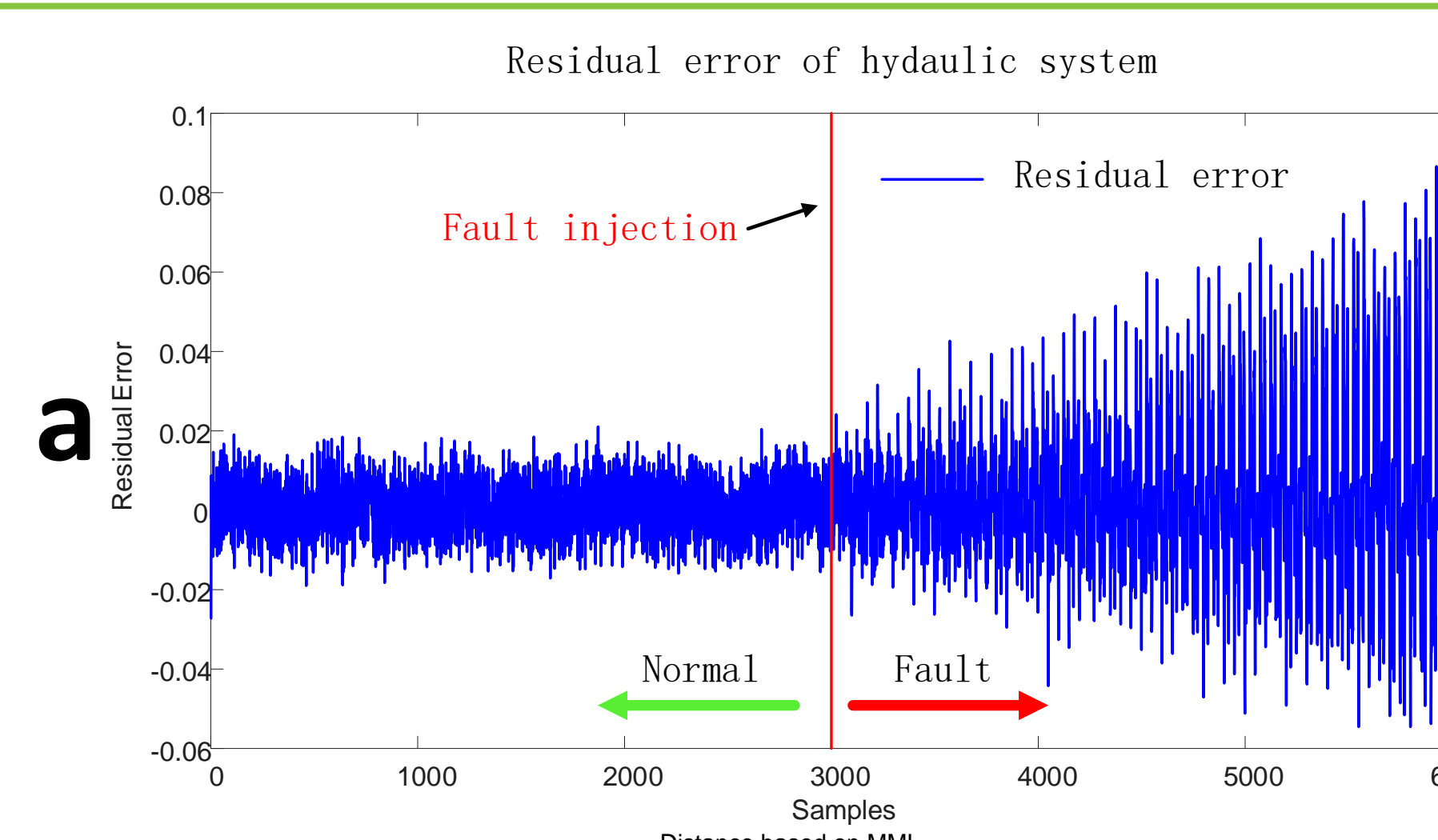
Simulation model was established in HyPneu and Simulink joint environment.

Electronic amplifier gradual faults with 3 degradation rates were introduced into the model.

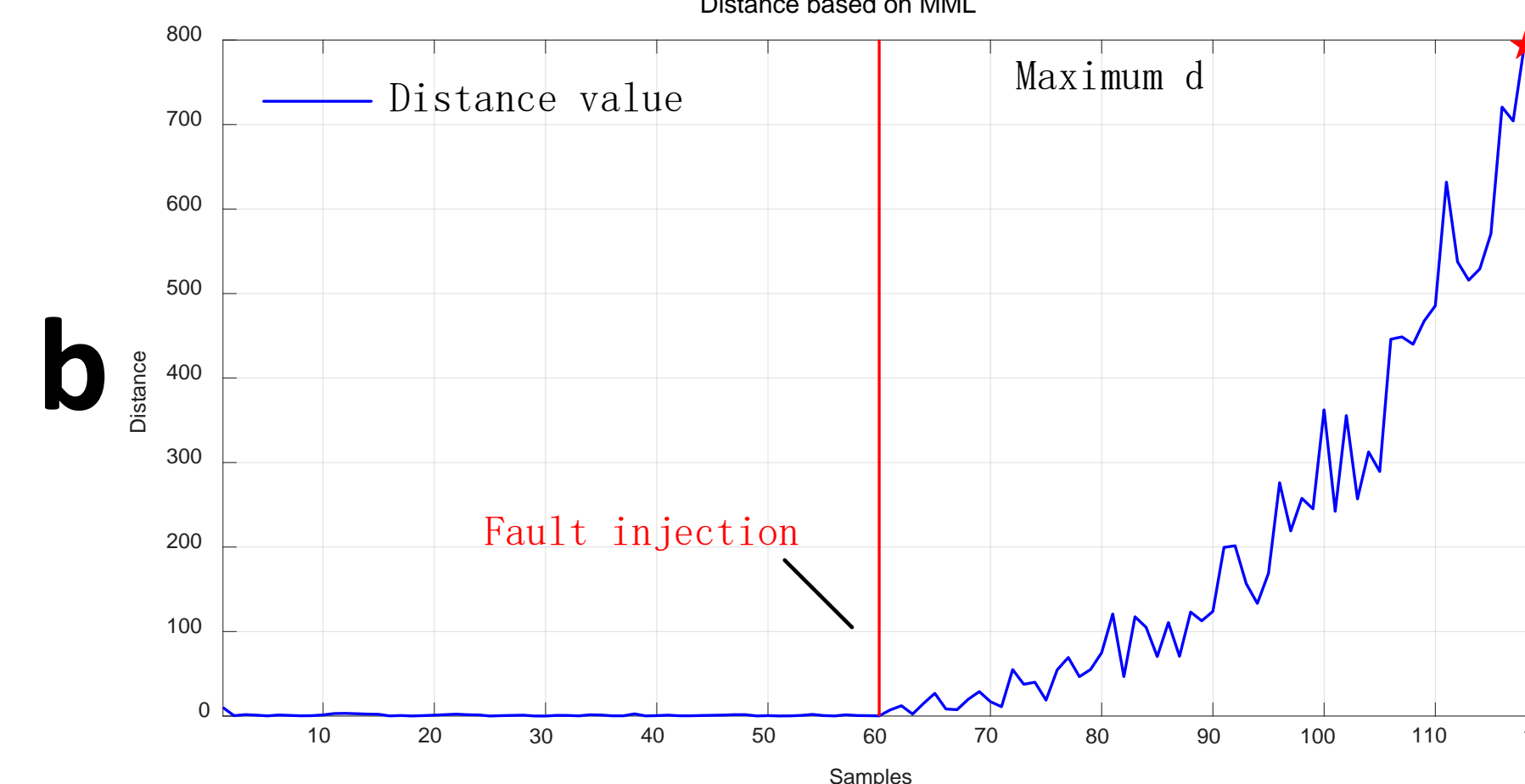
Confidence value (CV) represents the health degradation and reflect the different degradation rates.

## Next Steps

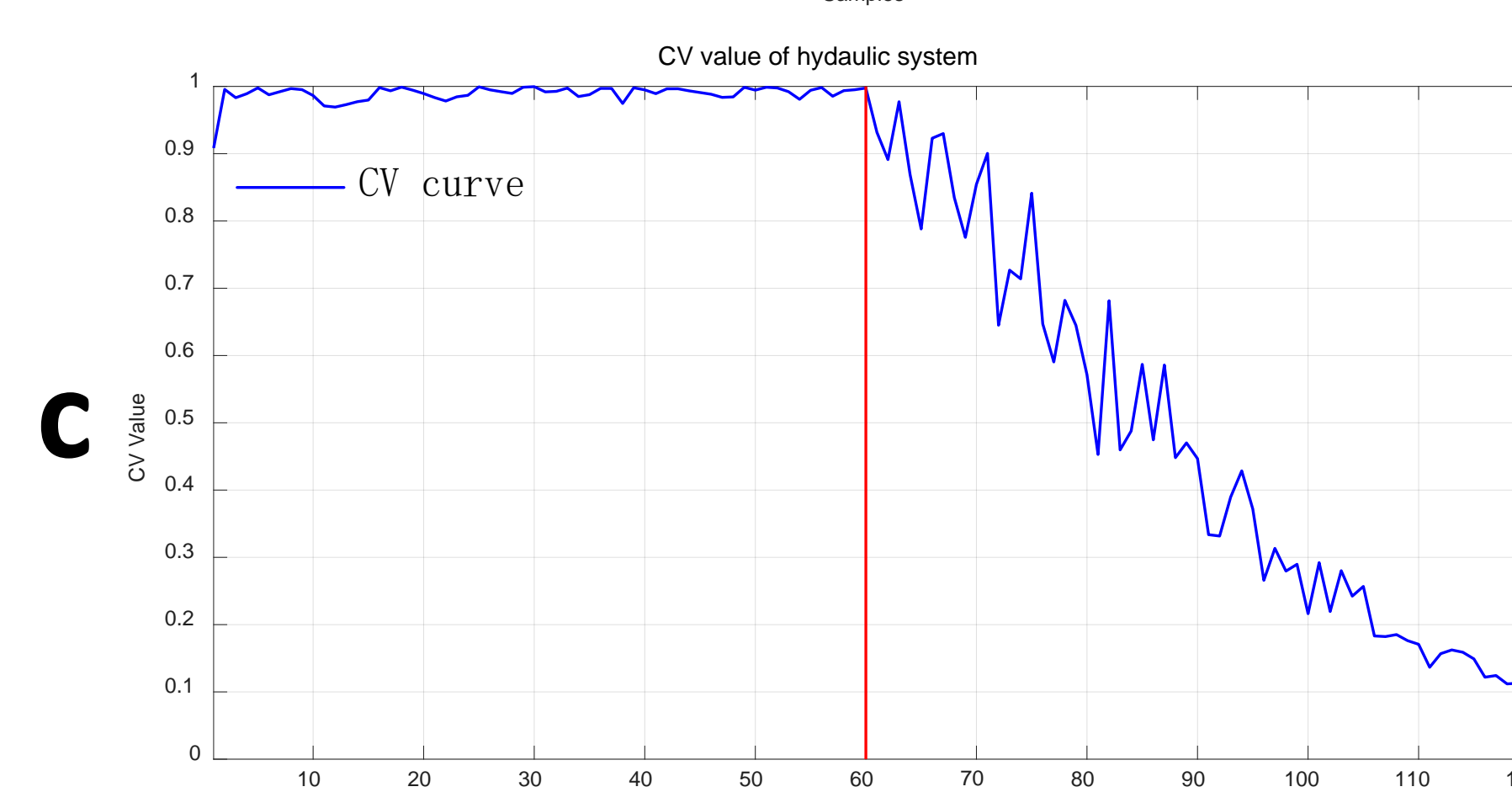
- Simulation model can be further improved and more faults injected to verify the effectiveness of the algorithm.
- Normal and fault data from real industrial scene can be also used to verify and improve the algorithm. Therefore, the algorithms can be applied in practice



**Figure a** : Residual error derived from health baseline of testing data with fault.



**Figure b** : Distance between normal state and fault state based on MML.



**Figure c** : CV normalized by distance.

CVs can be employed as an effective index for health and performance assessment.