Fault diagnosis in an unmanned aerial vehicle based on statistical time series methods

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Supervisors

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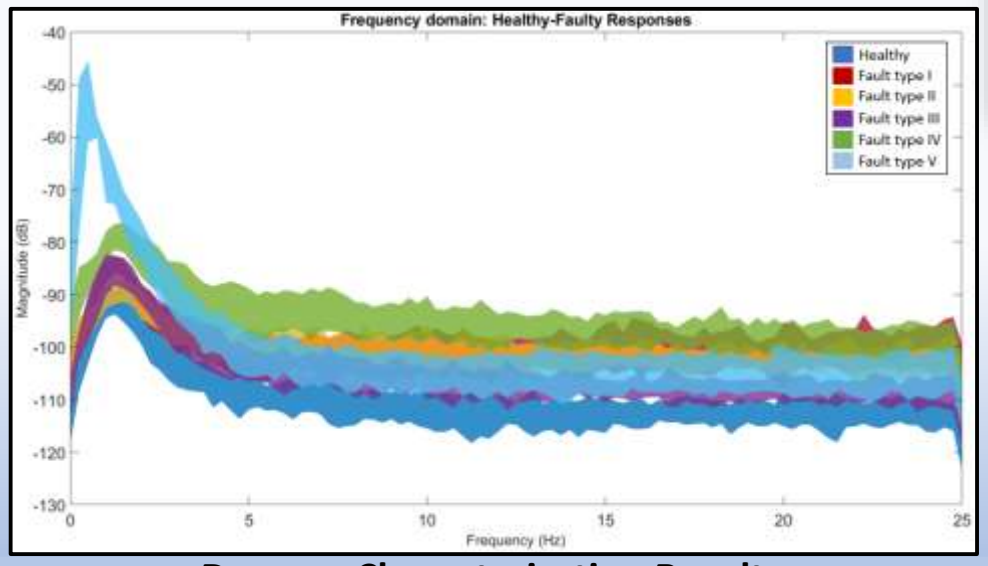
General Problem

Propeller damage diagnosis in multi-rotor Unmanned Aerial Vehicles (UAVs) using embedded vibration sensors.

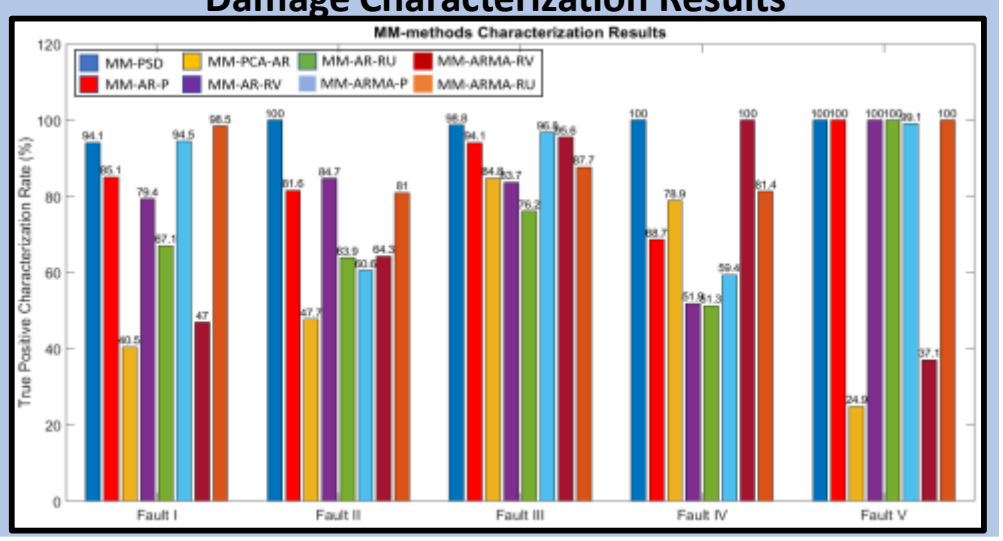
Study Goal

- Damage diagnosis including detection and characterization of early stage damages in the propeller of a quadcopter using a single embedded vibration sensor.
- Experimental assessment of 4 damage detection and 8 damage identification statistical time series methods of machine learning type.

Effect of Damage Scenarios



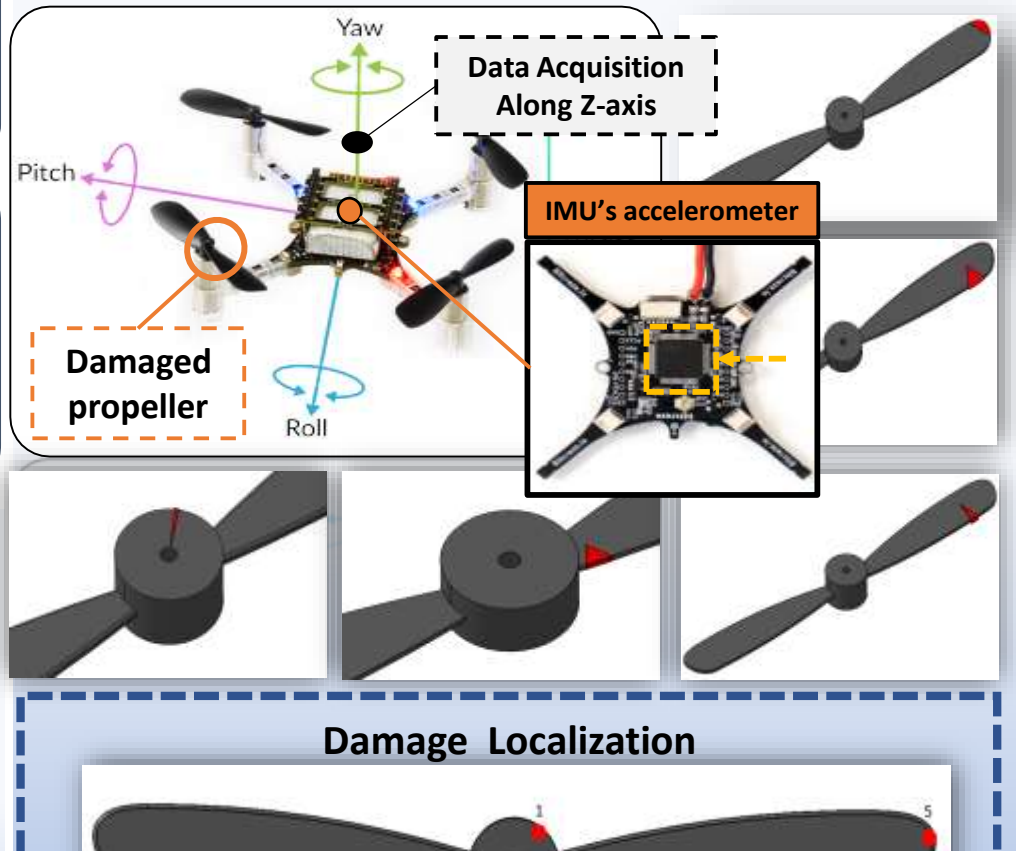
Damage Characterization Results



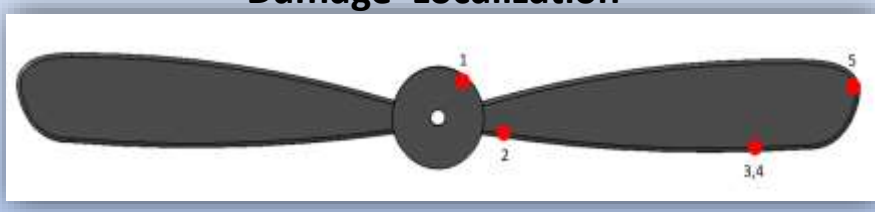
Experiments and test cases

Healthy	Fault 1	Fault 2	Fault 3	Fault 4	Fault 5
30	20	20	20	20	20
Damage Detection					
Baseline Phase		Inspection Phase		Test Cases	
1		129		3 870	
Damage Characterization					
Baseline Phase		Inspection Phase		Test Cases	
10		10		1 000	

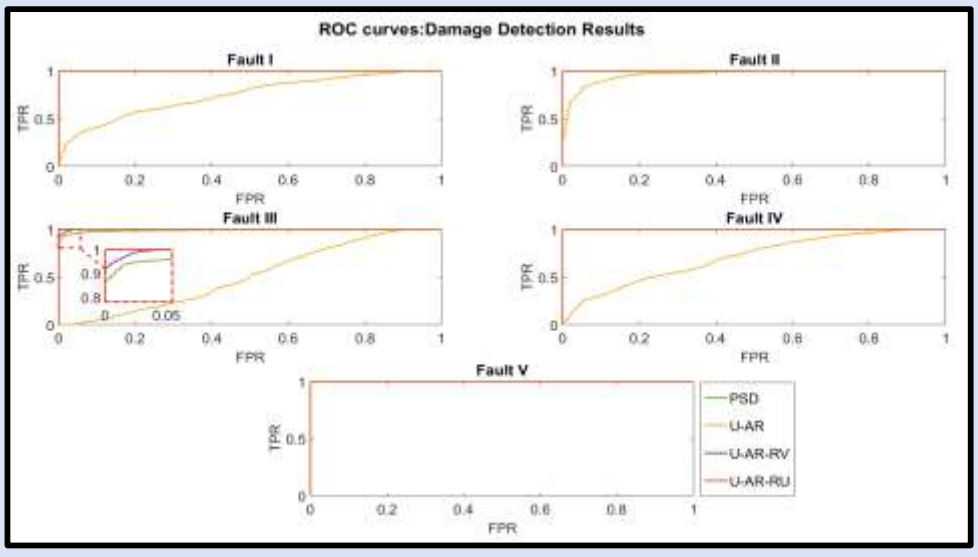
The Damage Scenarios



Damage Localization



Damage Detection Results



TPR: True Positive Rate (Correct detection)
FPR: False Positive Rate (False alarm/Missing fault)
(Perfect performance: Left upper corner, TRP=1, FPR=0)

Concluding Remarks

- Damage diagnosis on the propeller of a quadcopter is achieved using a single vibration sensor and on-board measurements.
- Damage detection is accomplished with optimum results via the AR-U method with 100% TPR for 0% FPR in all considered every damage scenarios.
- Damage characterization results indicate the overall superiority of the MM-PSD method that achieves 94.1% of correct characterization in the worst case scenario.