

Automatic crack detection in aerospace structures using acoustic emission

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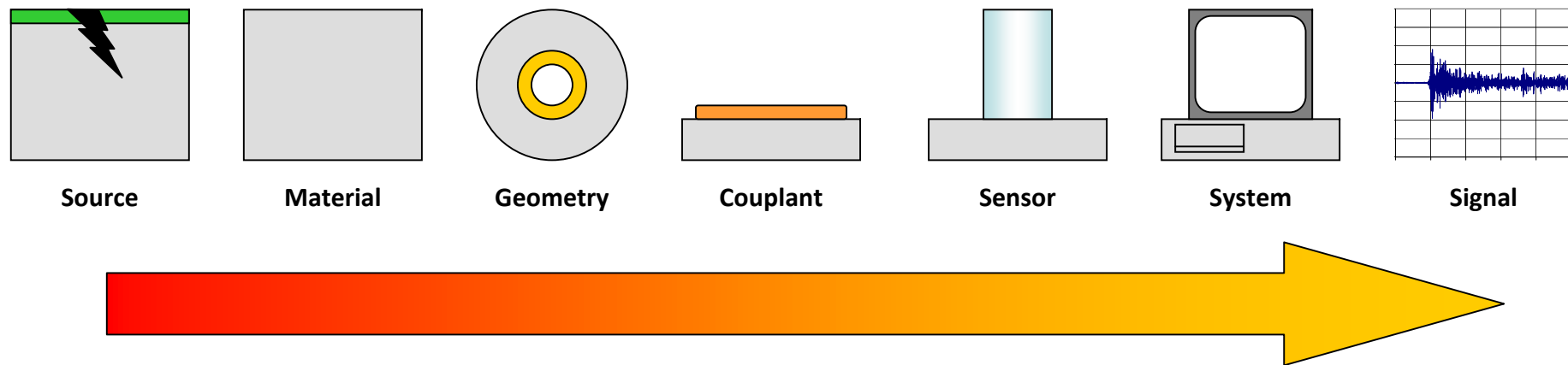
Sheffield University



- Research problem
- Acoustic emission (AE)
- Developed solution
- Experimental example
- Conclusions

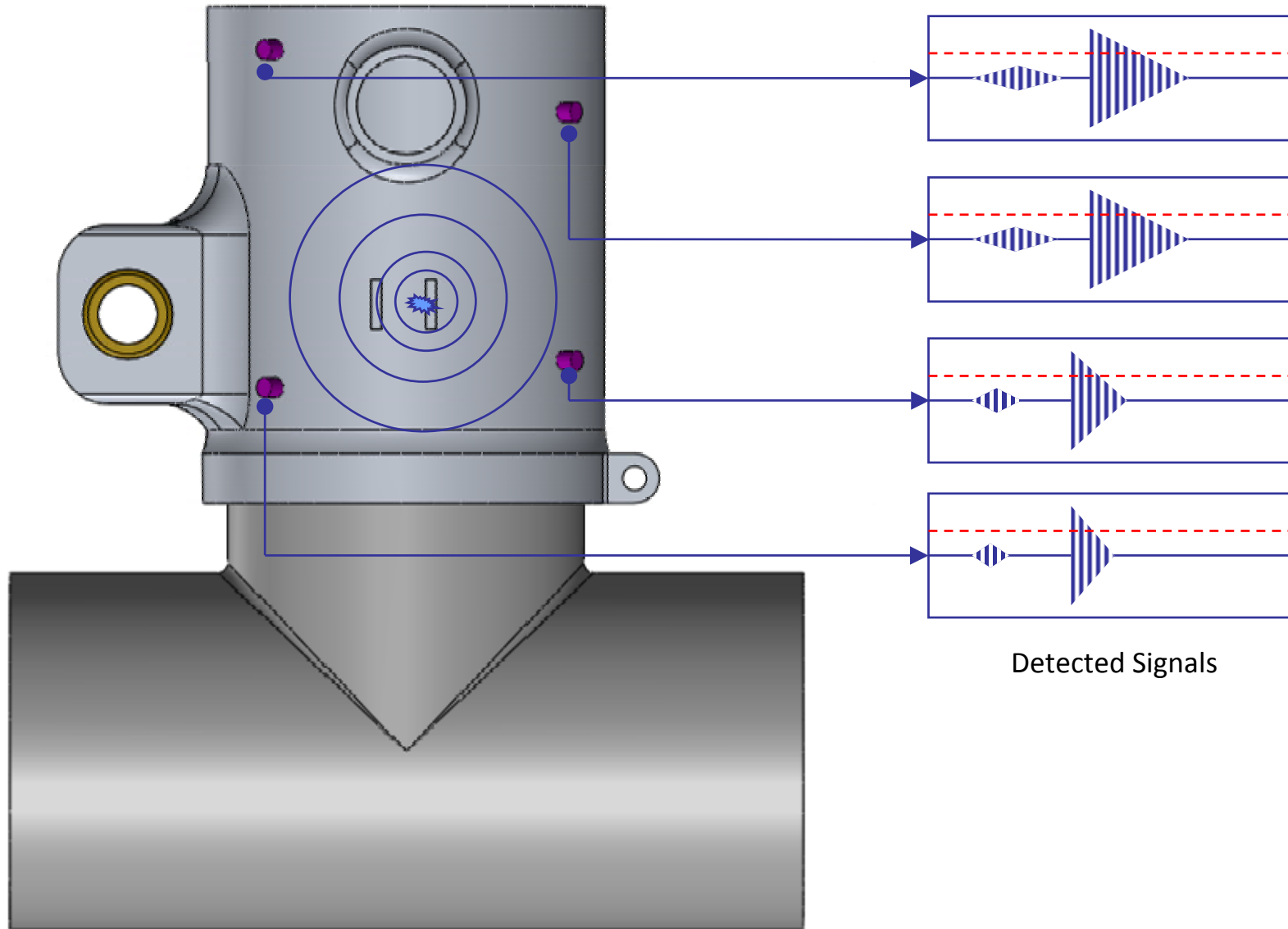
- Research sponsored by EPSRC & Messier-Dowty a leading manufacturer of landing gears
- Research team of Cardiff University, Sheffield University, National Physical Laboratory and Physical Acoustics Limited
- Creation of system to detect, locate and identify fractures in landing gears undergoing airworthiness certification tests
- Certification tests are a high noise environment making source location and identification difficult
- Currently laboratory testing to demonstrate a Technology Readiness Level of 5

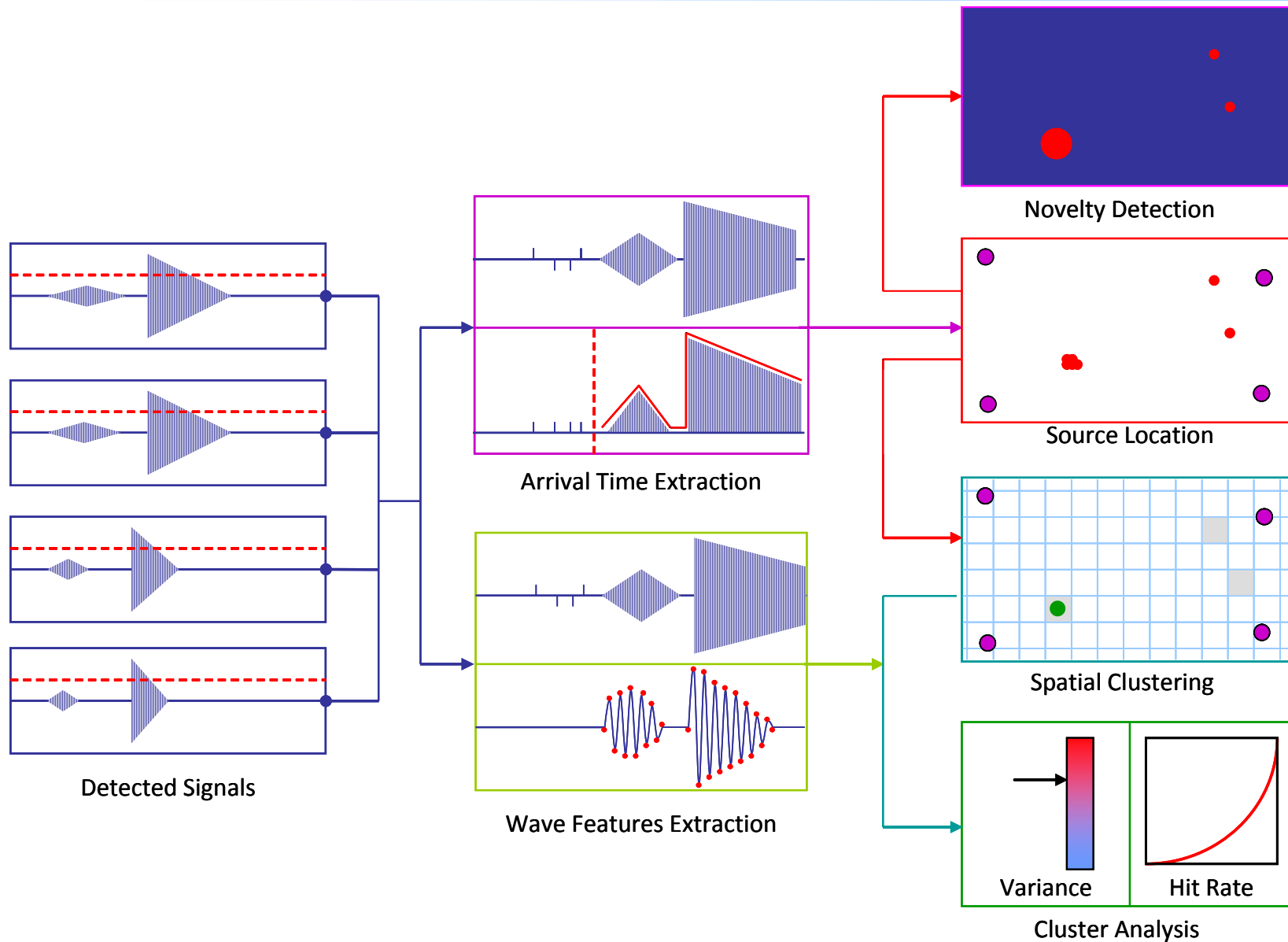


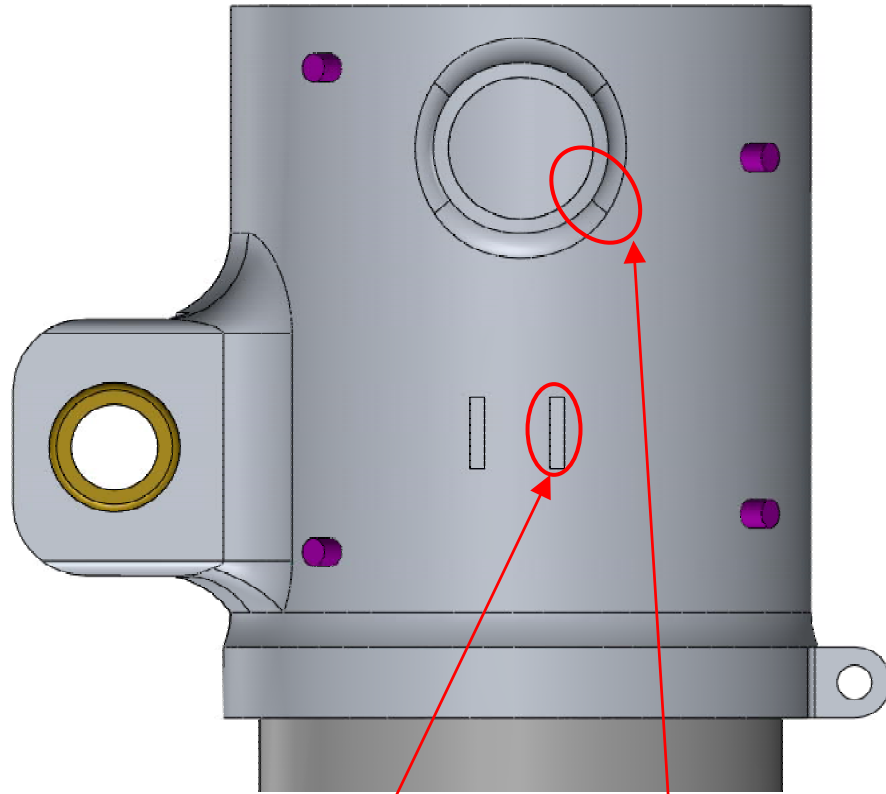


- AE transfer function is very complex with many variables
- Requires the solution of a 'massively uncertain inverse problem'

Developed solution



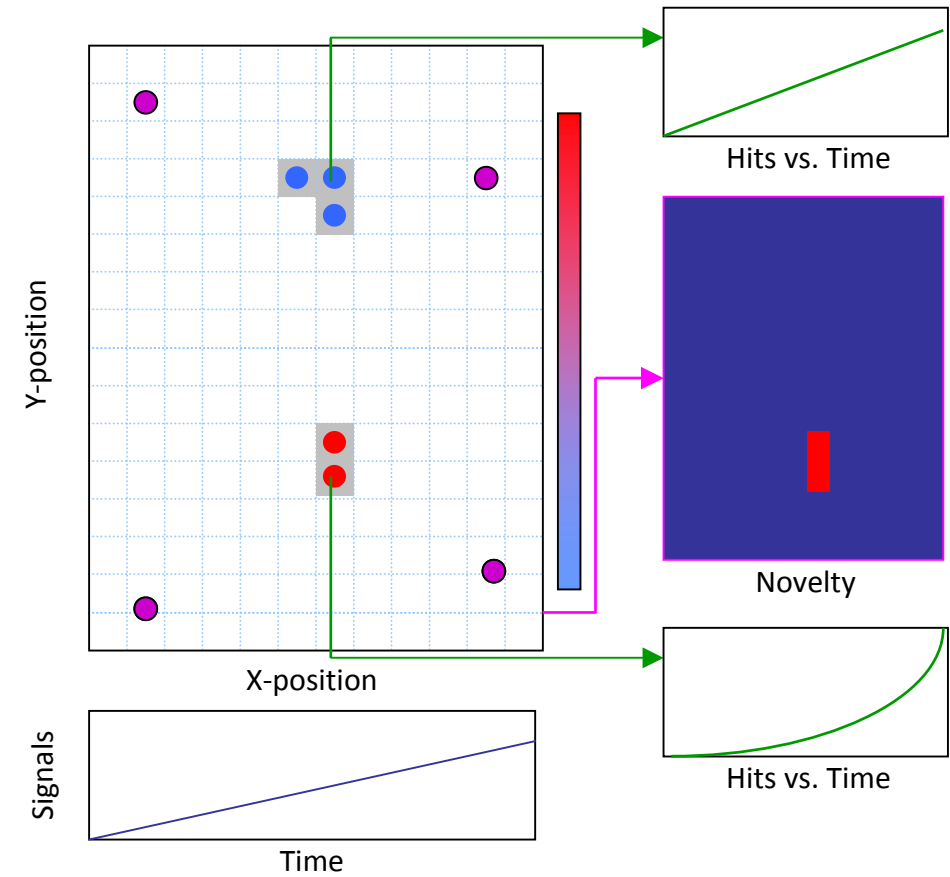




Fatigue fracture

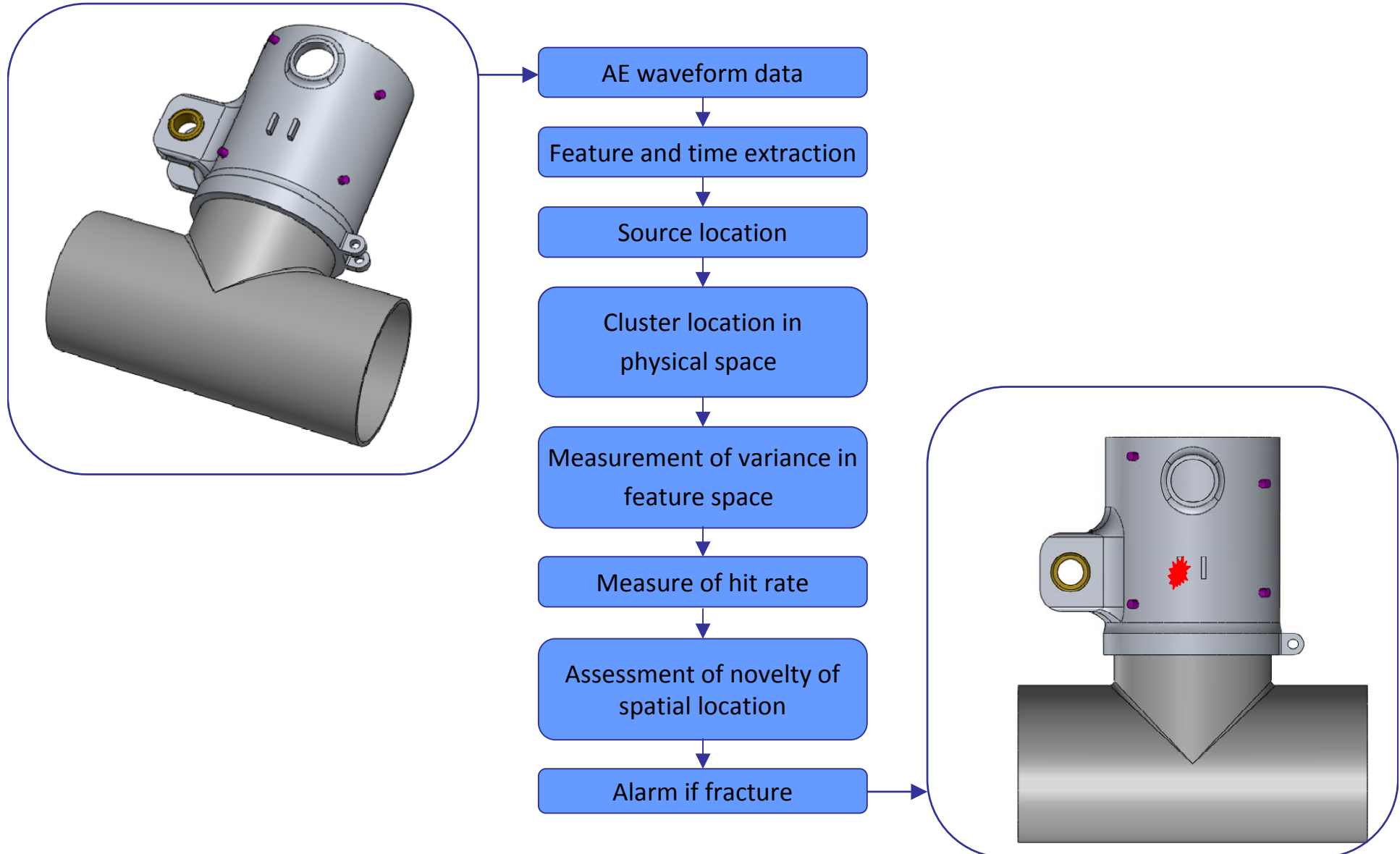
Noise due to sliding tube

Test Example

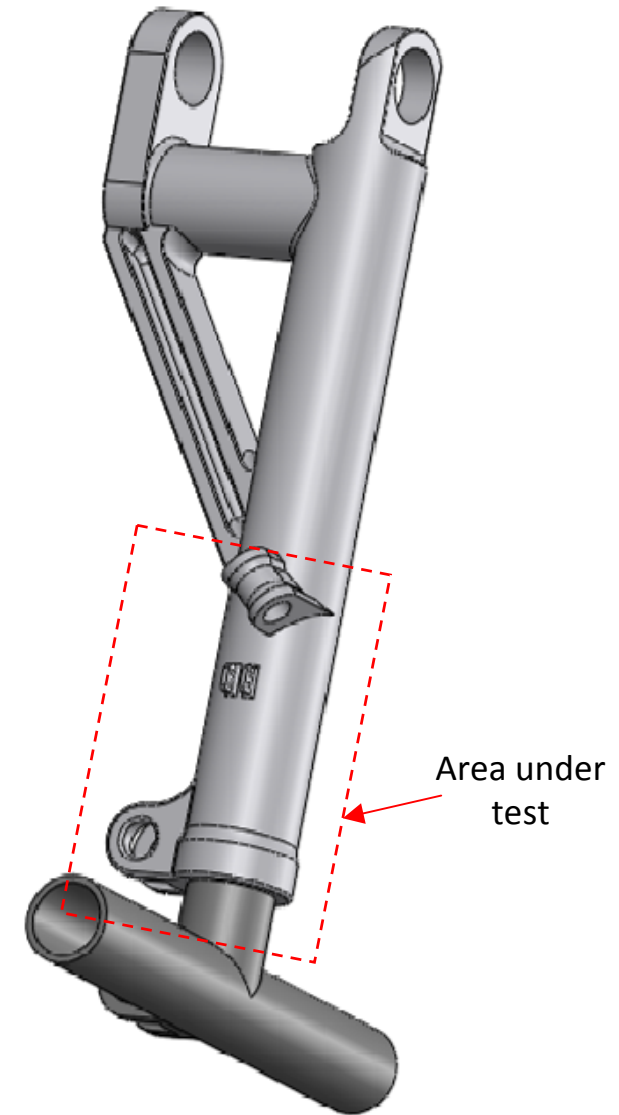


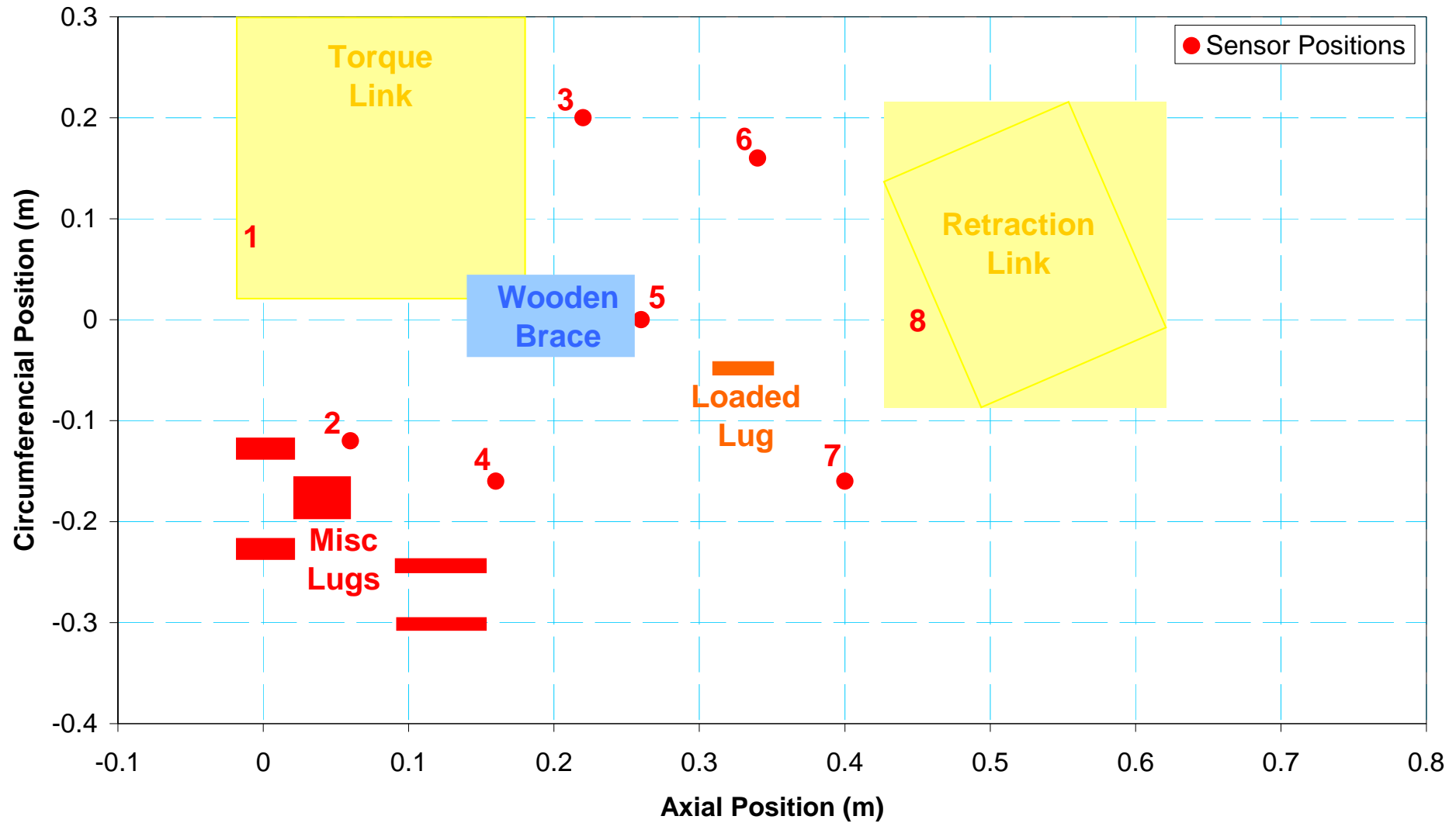
Analysis Example

Developed solution summary

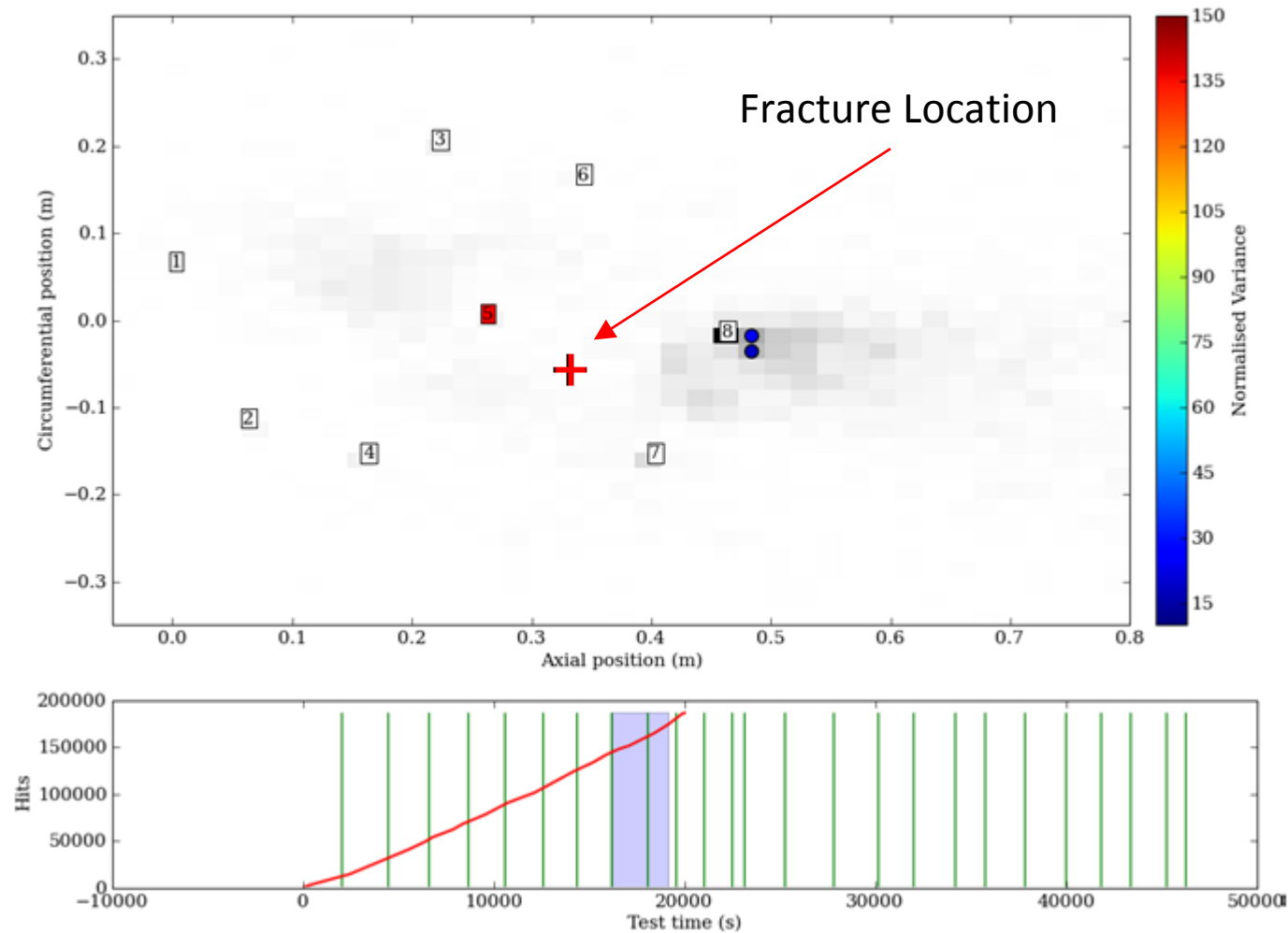


- A fatigue test of a 300M lug, welded at the site of a previous fracture
- Test conducted on an A320 main fitting
- The sliding tube was activated throughout the test to provide realistic background noise levels
- Lug was loaded continuously until failure (0.55-5.5 kHz at 1 Hz)
- All analysis completed post test - 44.5k cycles

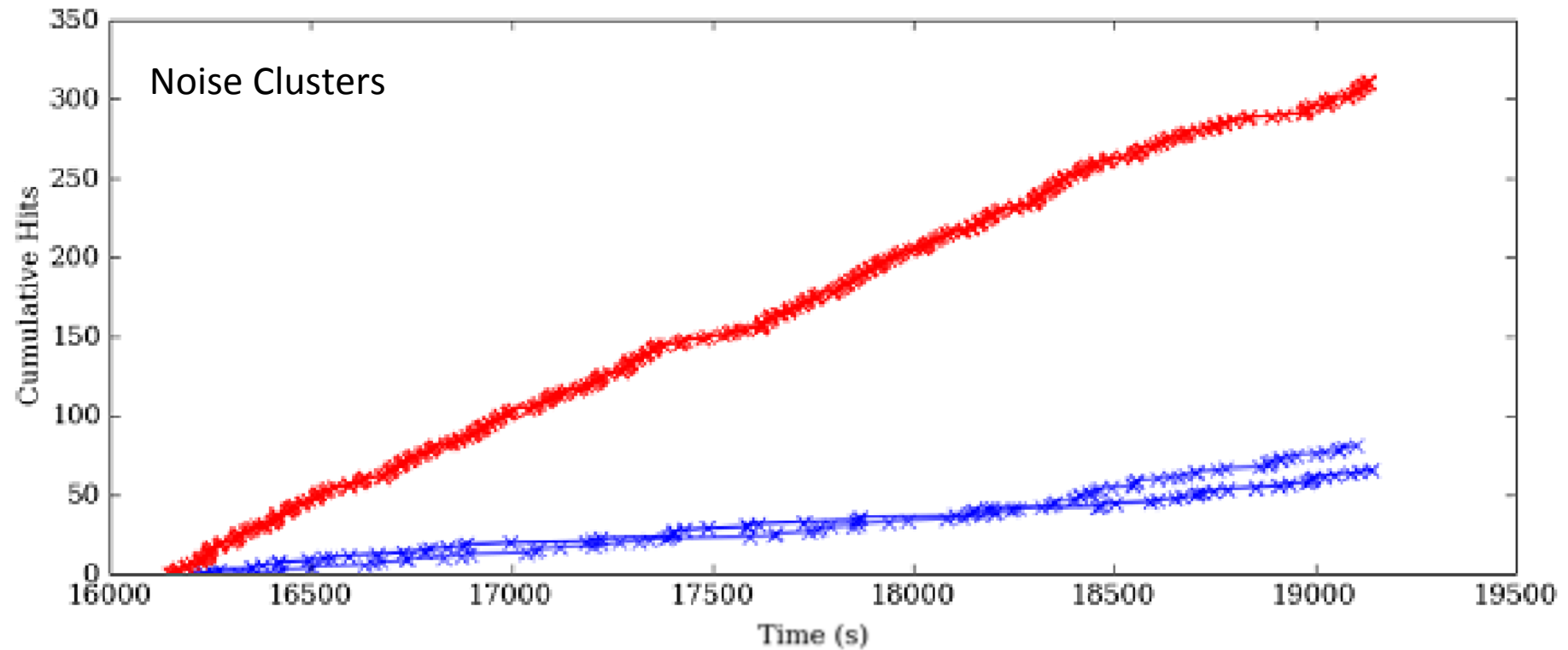




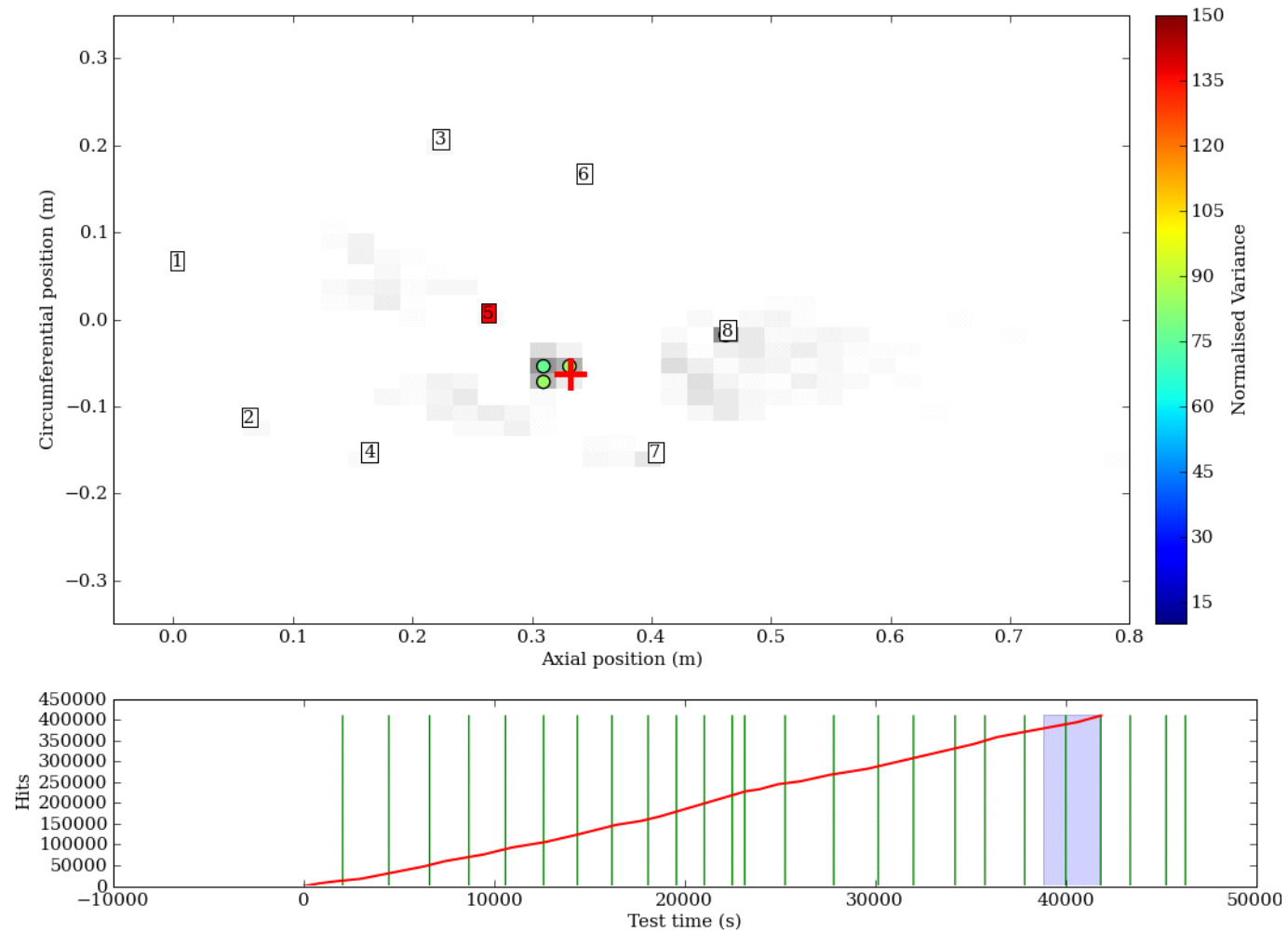
Experimental example-results



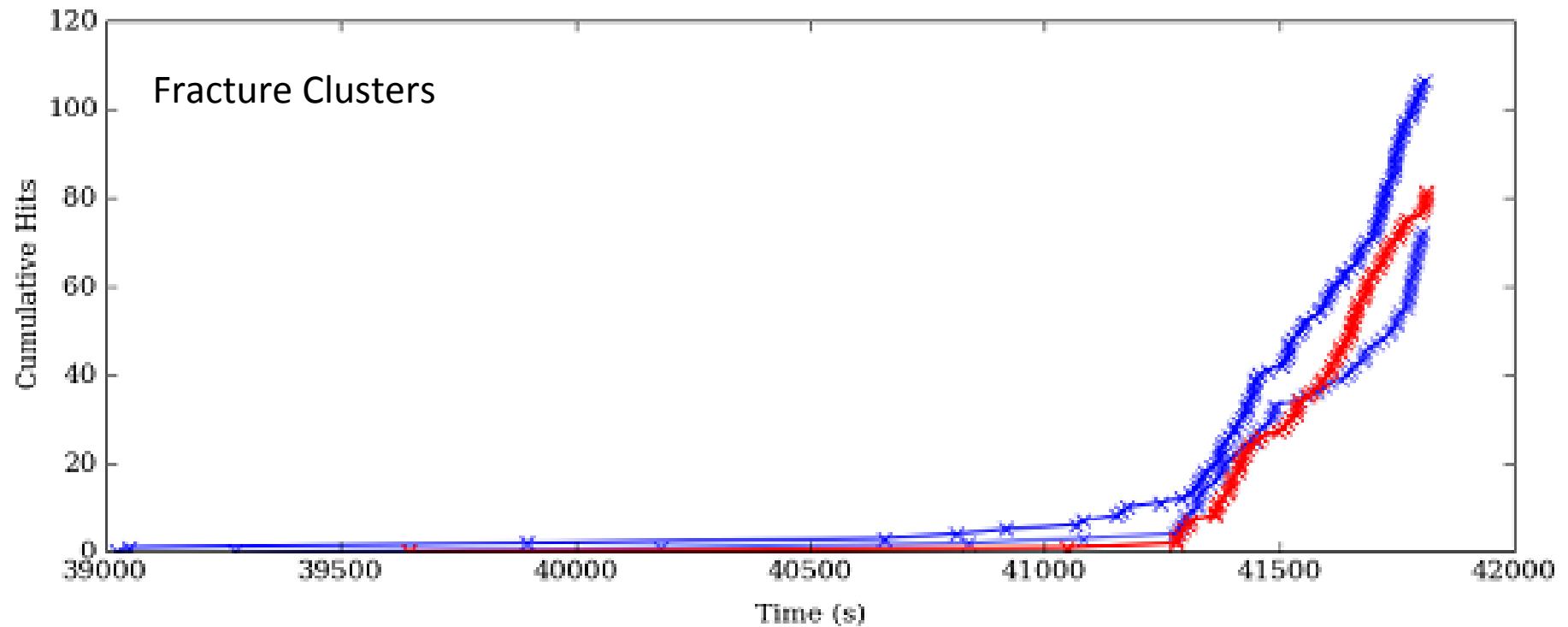
Experimental example-results



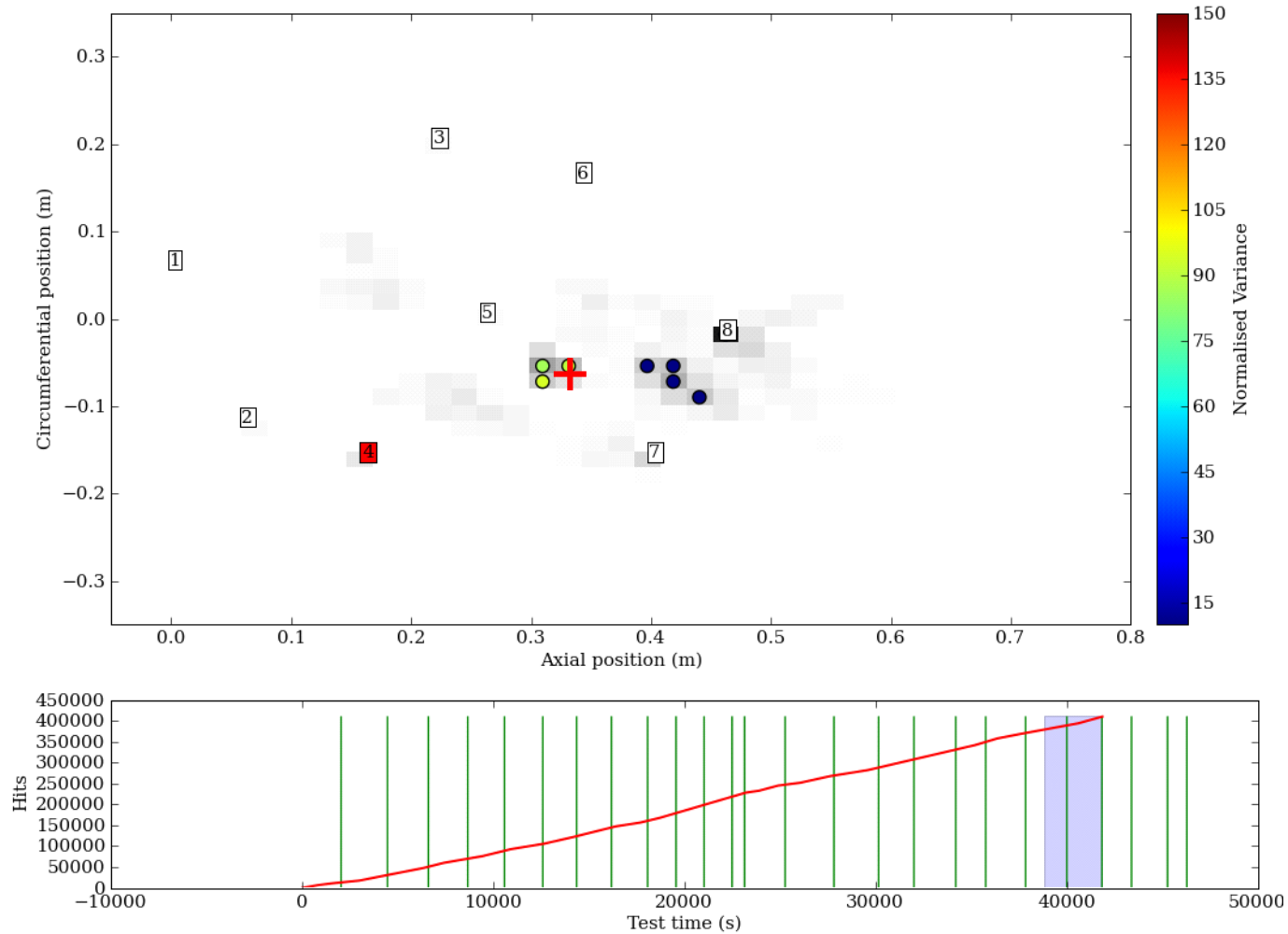
Experimental example-results



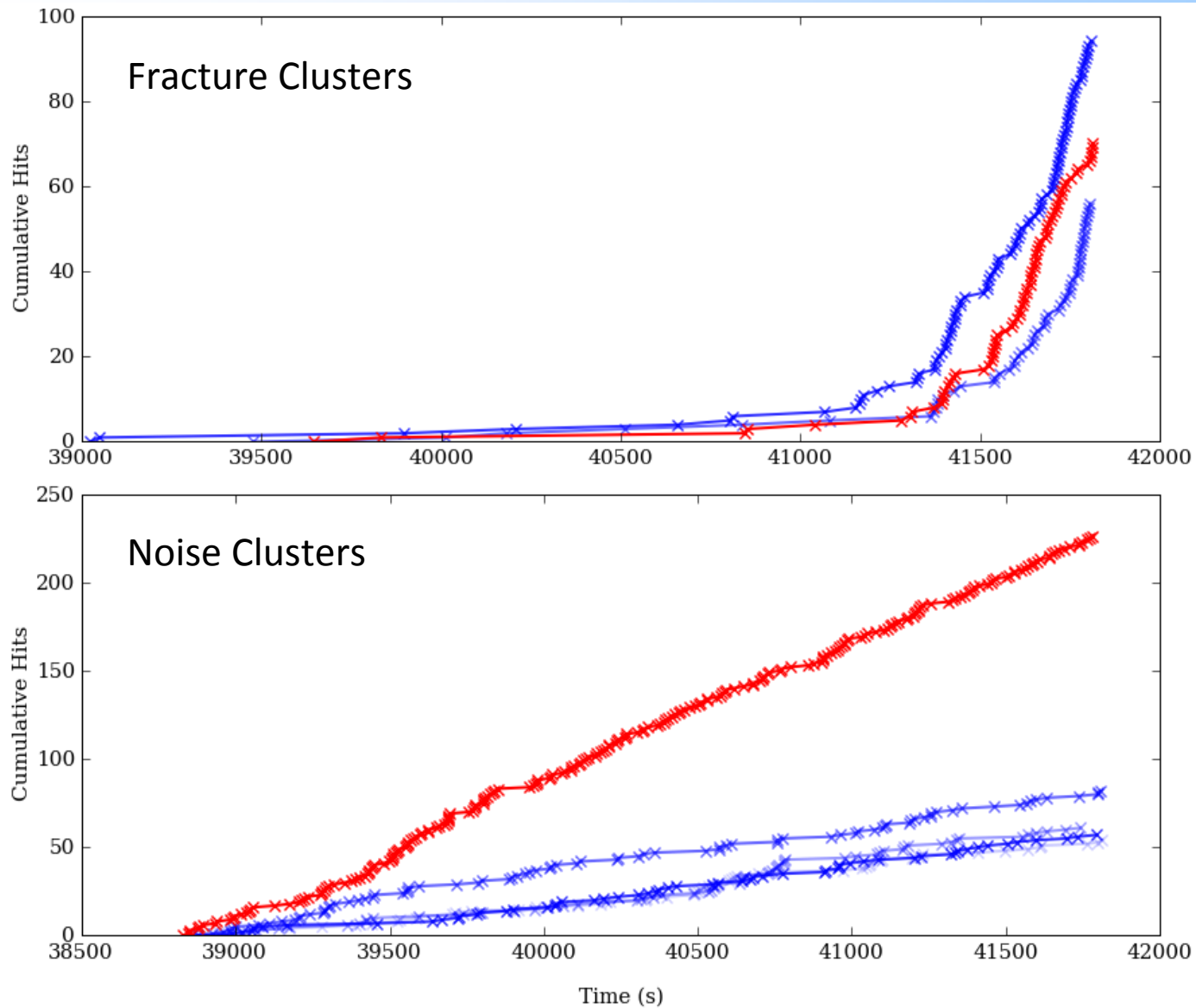
Experimental example-results



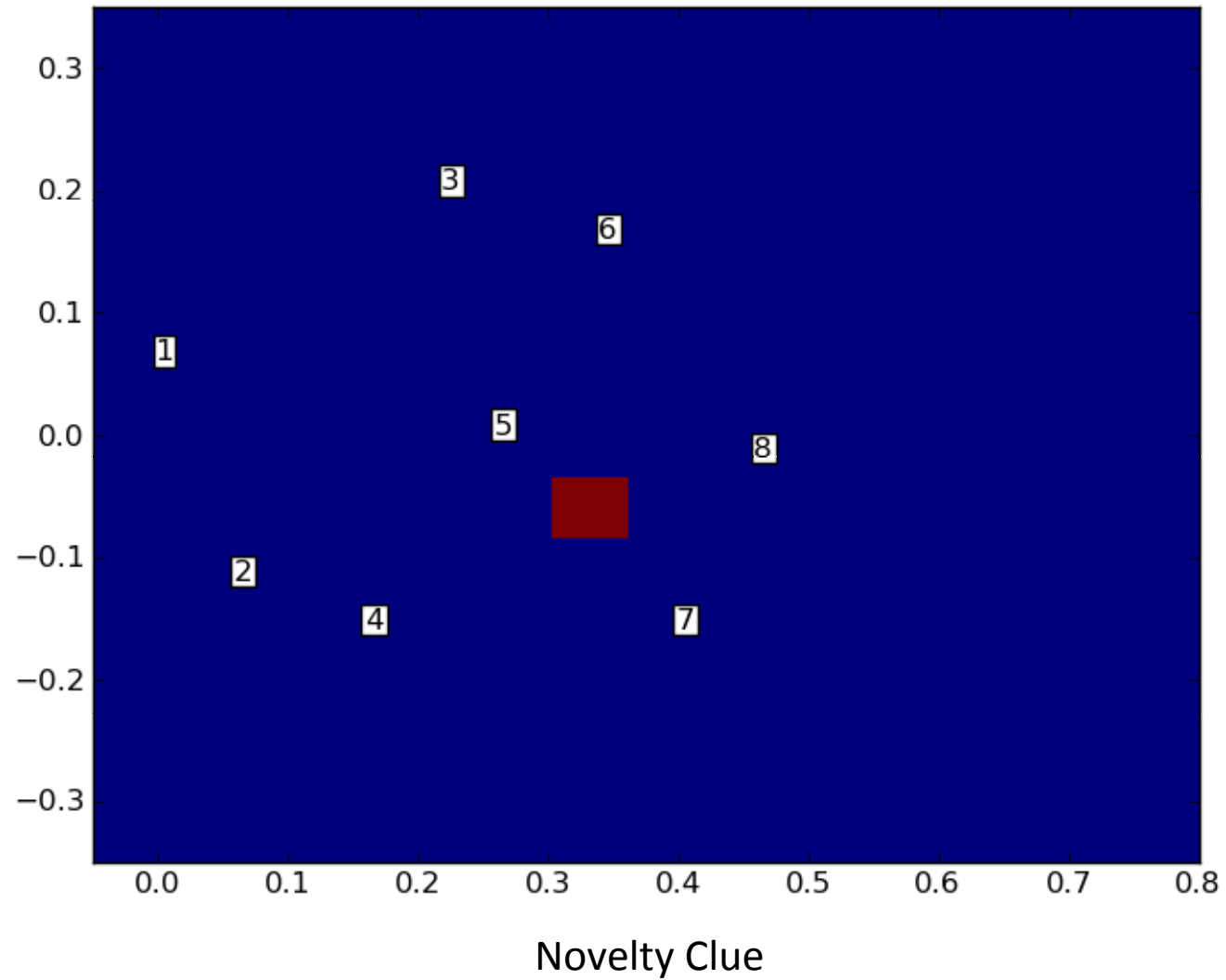
Experimental example-results



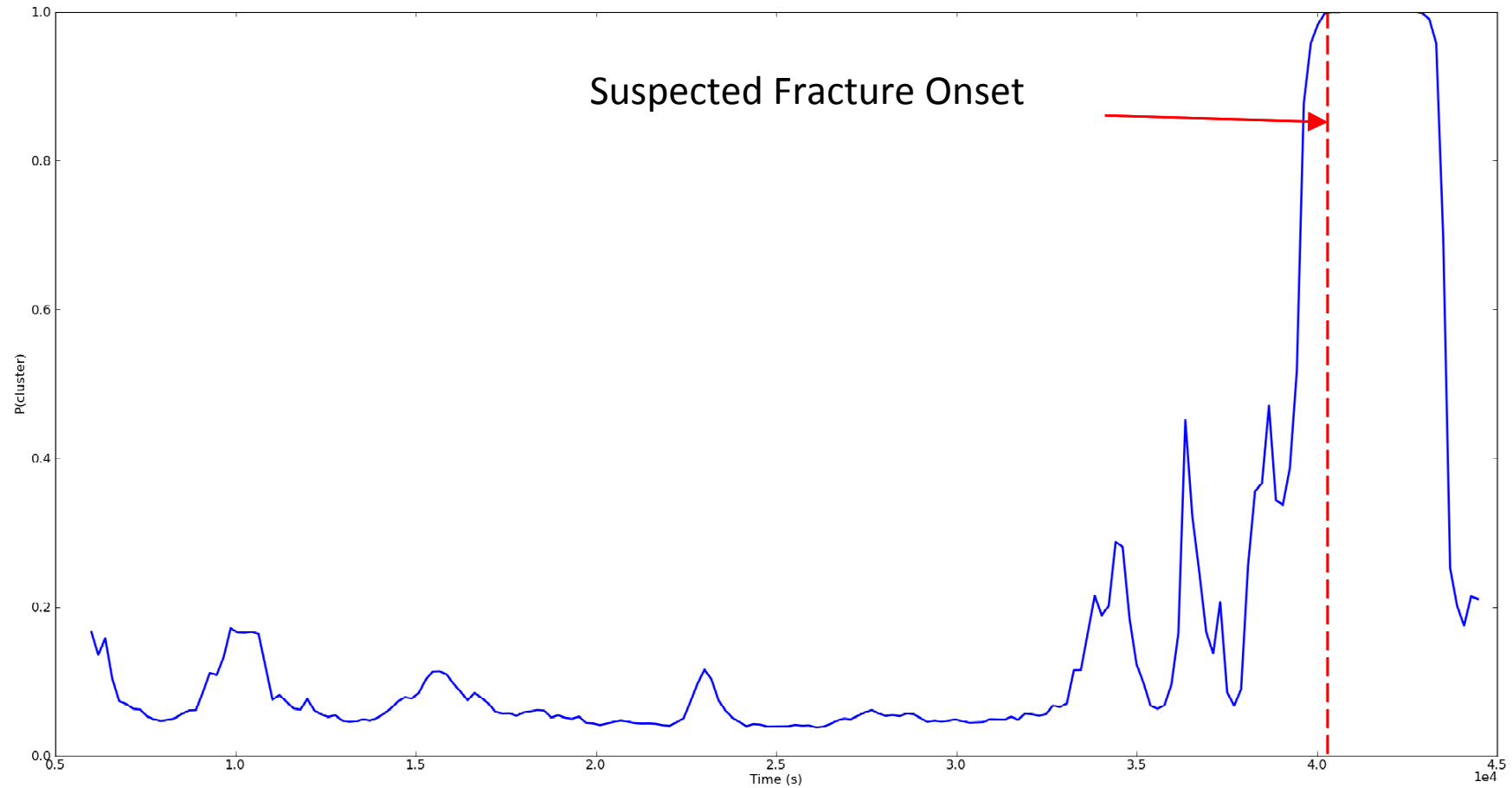
Experimental example-results



Experimental example-results

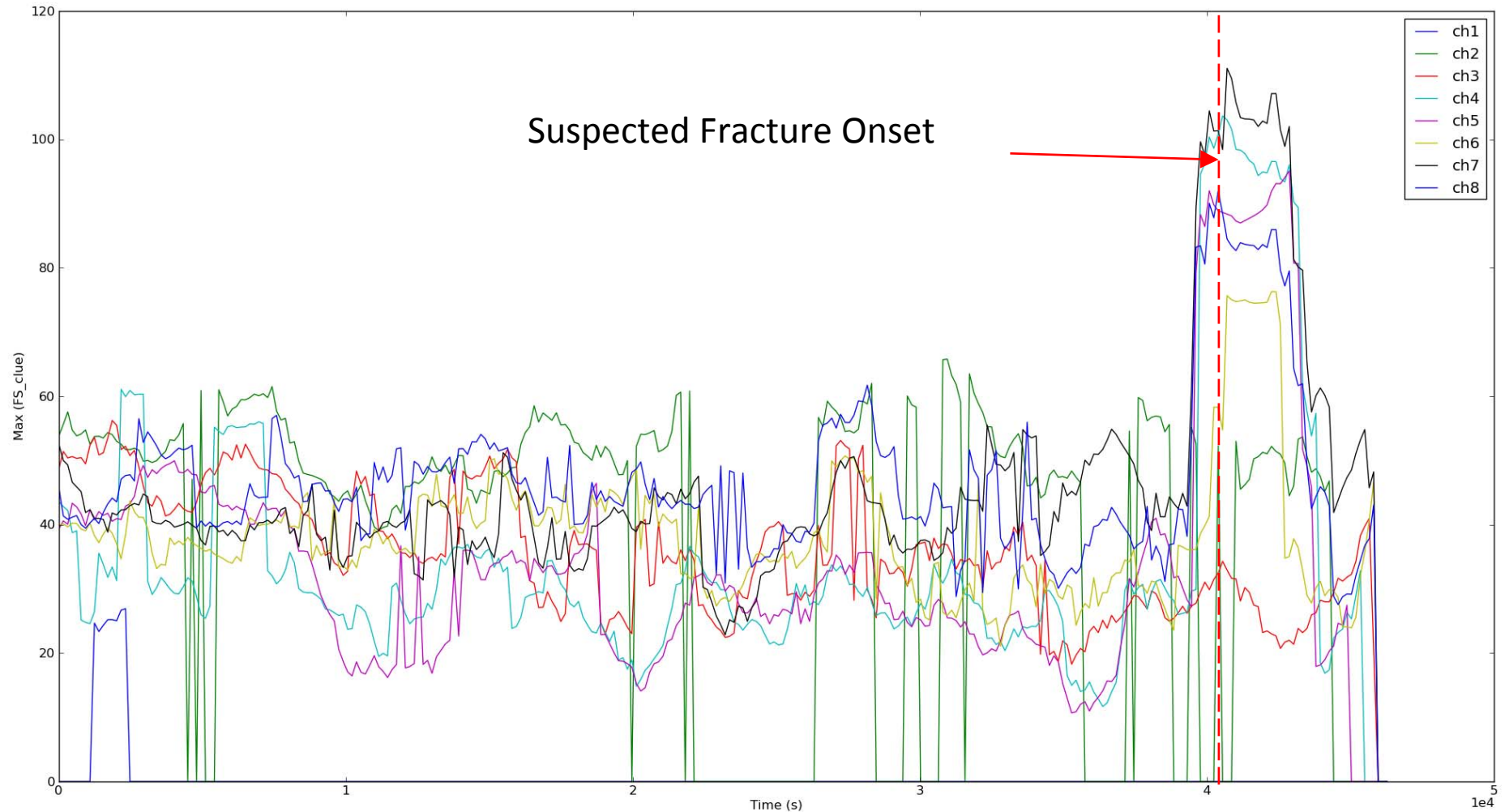


Experimental example-results



Novelty Clue

Experimental example-results



Variance Clue

- Examination of the normalised variance score of clusters in the lug region after the detected onset of fracture, were shown to be considerably higher (75-95) than noise sources (30-45).
- Hit trends immediately after the onset clearly displayed an increasing gradient which was in contrast to the predominantly linear trends associated with noise clusters.
- An assessment of the novelty of located signals after 'bedding in' period identified the fracture region
- A complete analysis of the data set has demonstrated that the three identified 'clues' can successfully be applied to identify fractures in this investigation.