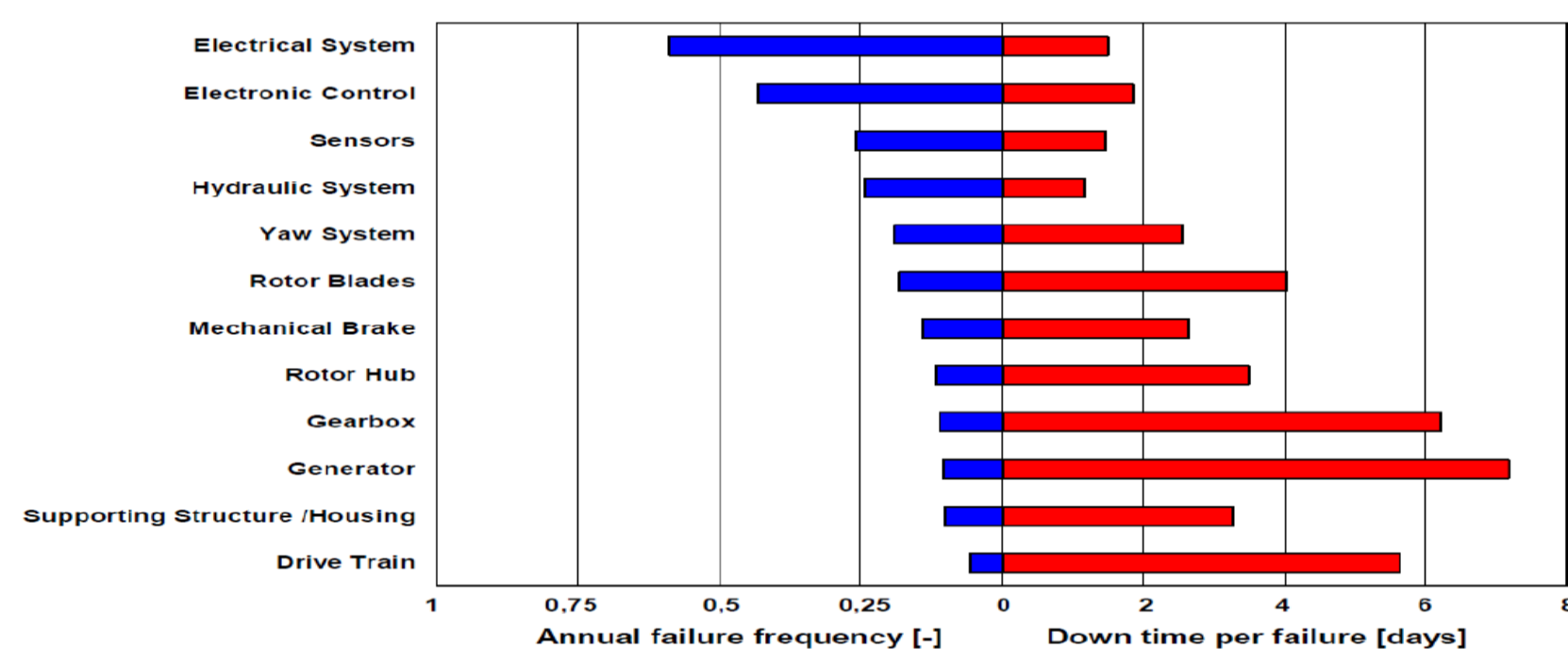


## Reliability of wind turbine generators

Generator faults can contribute significantly to the overall downtime experienced by a wind farm due to component failure, with around 1 failure per year in state of the art offshore wind turbines. The figure below shows the largest contributors to failure modes related to generators and associated failure rate [1].



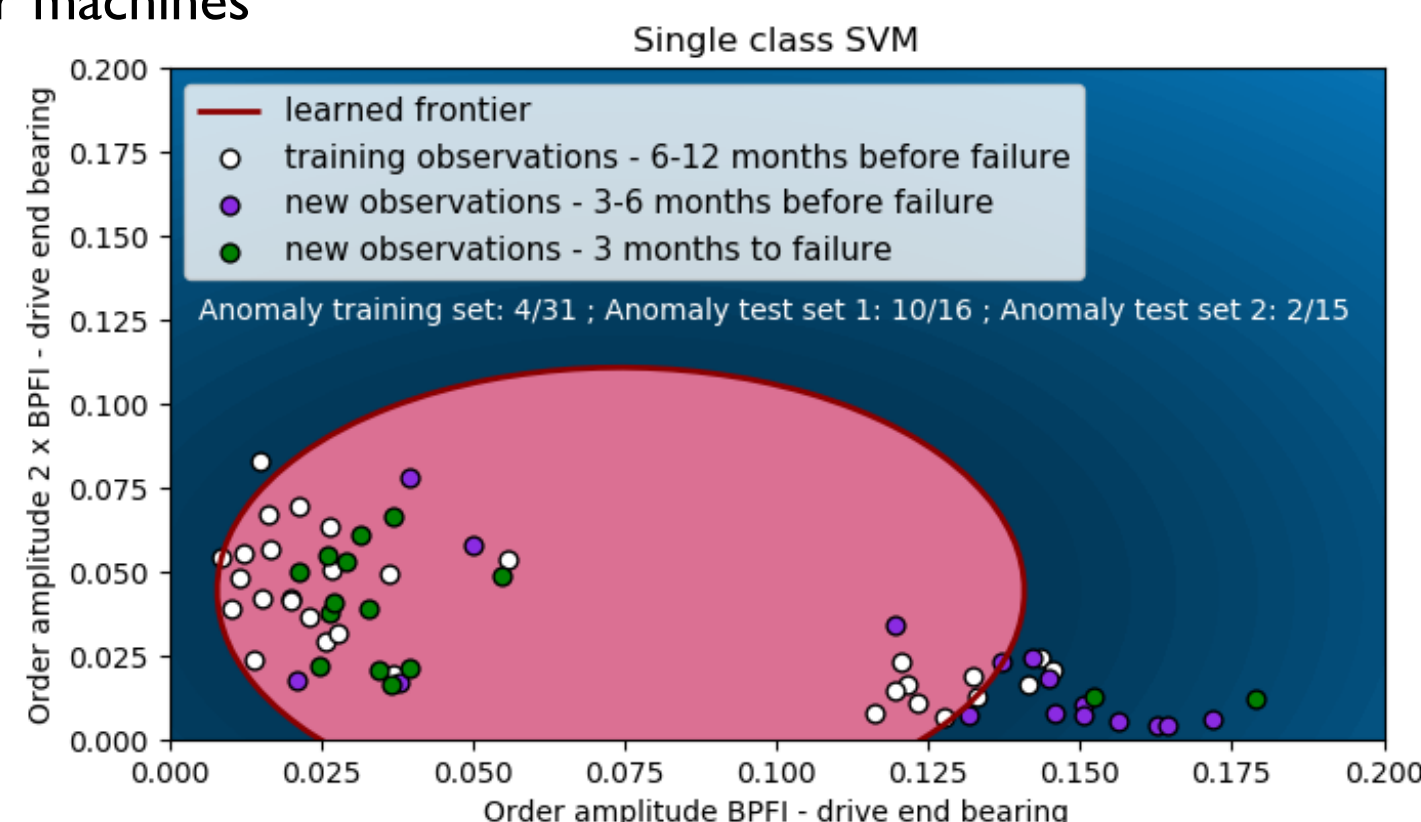
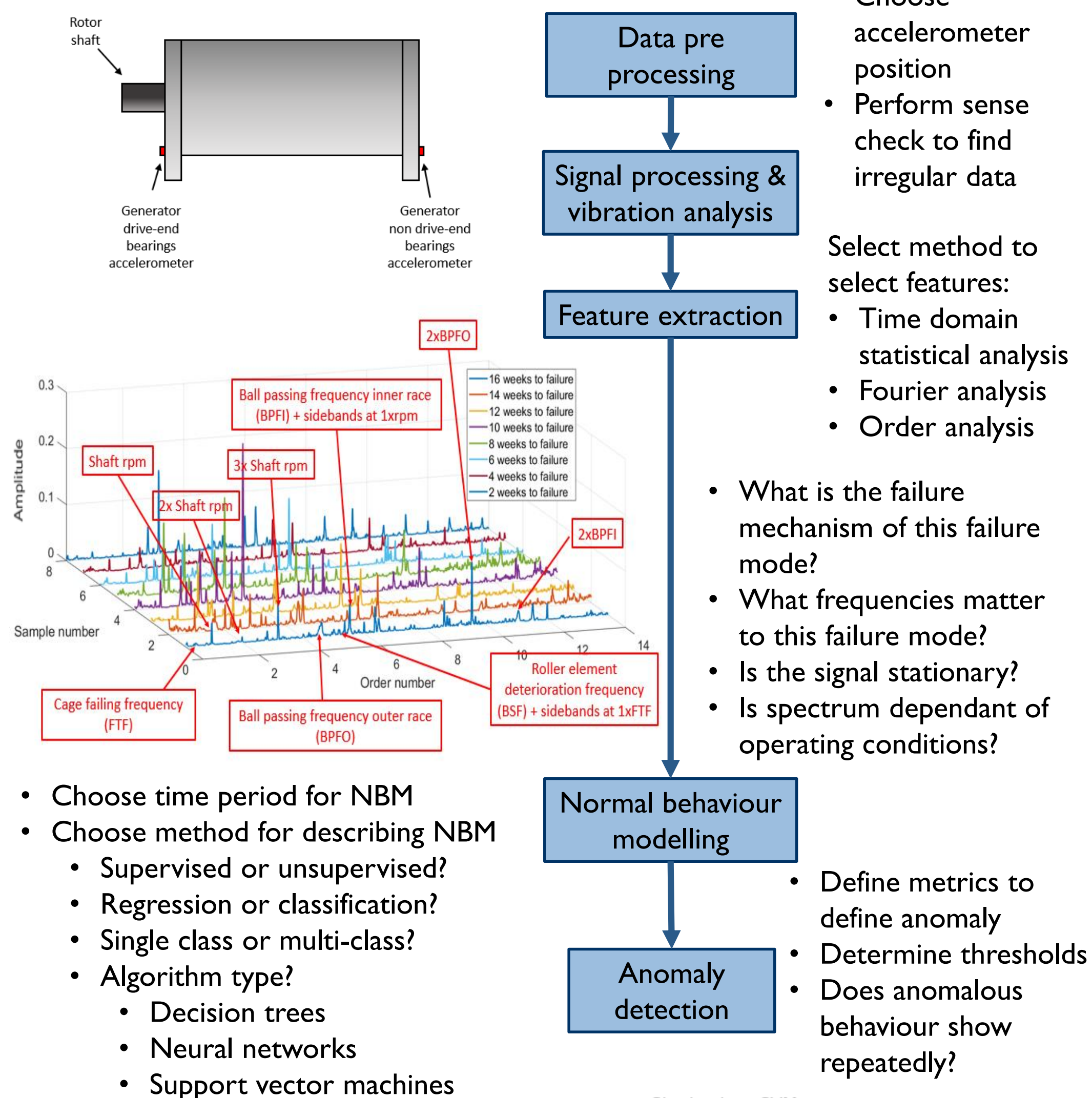
## Generator bearing failure

Bearings are the most common failure associated with doubly fed induction generators (DFIG) [2]. This bearing failure is due to fluctuating loads and raised temperatures causing wear and relative motion between the generator shaft and bearing inner race.

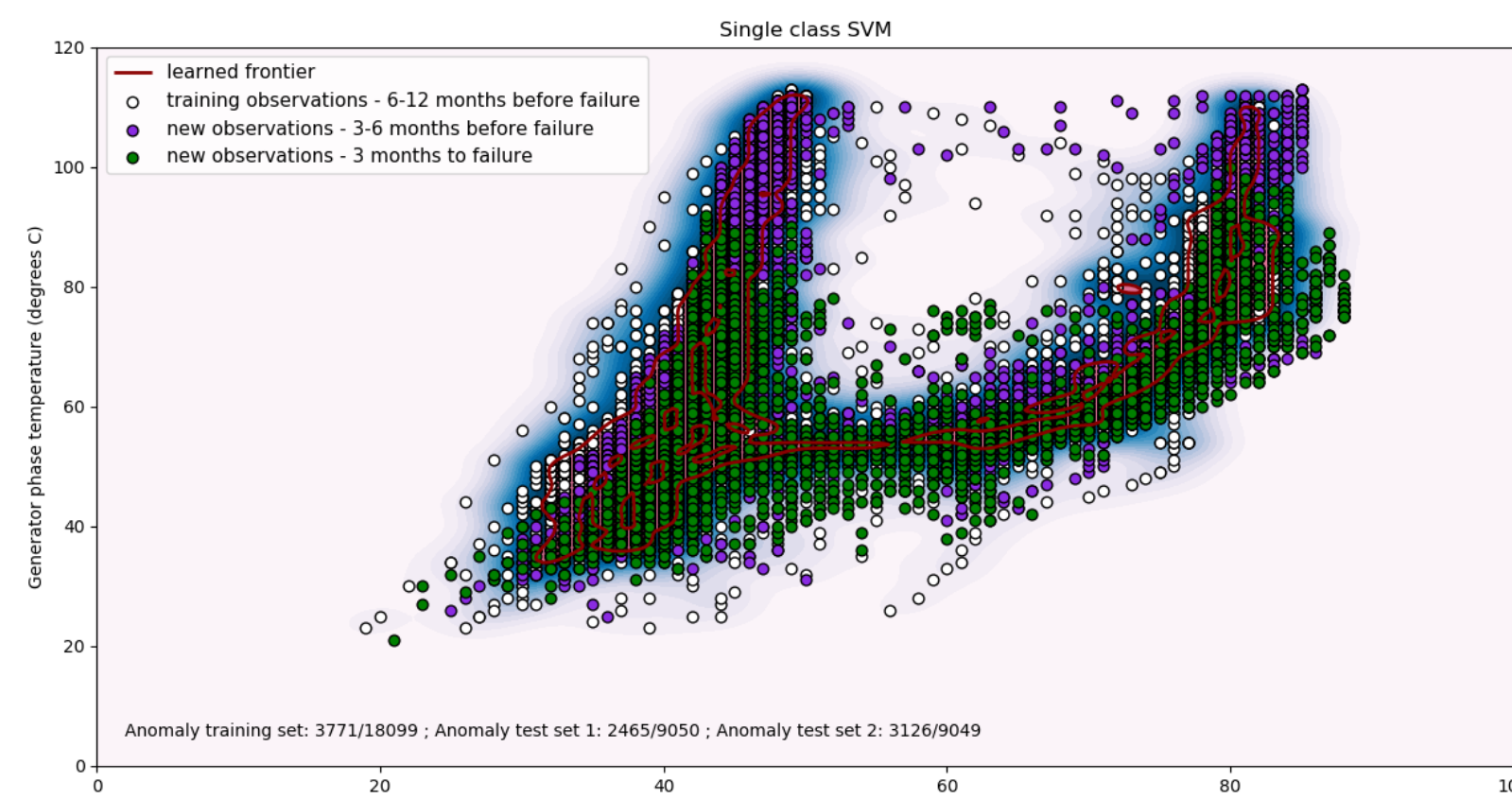
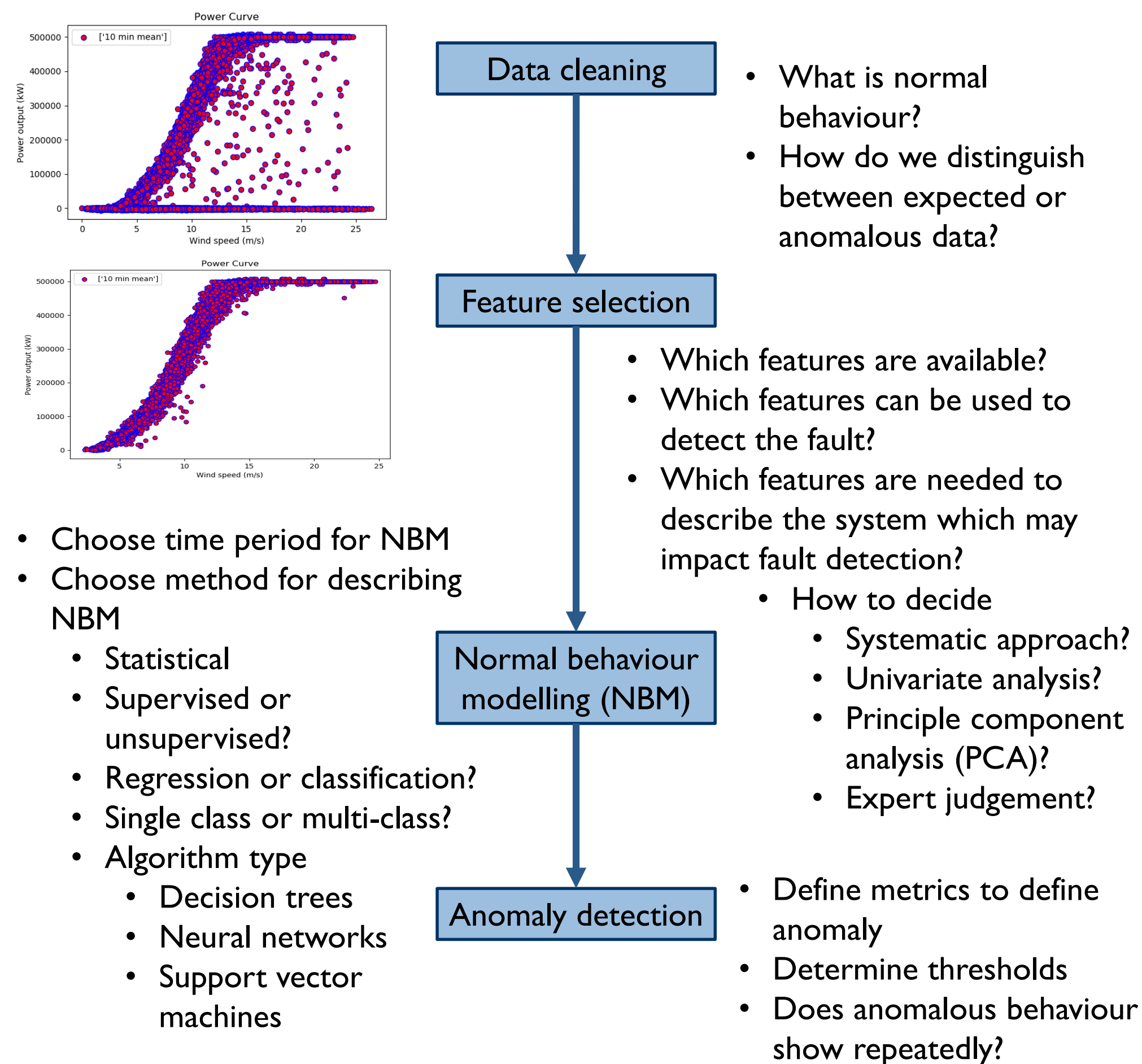
The figure below shows damage caused at the time of failure to the generator shaft (left) and inner race (right).



## Vibration analysis



## SCADA analysis



- Trained model with **20.8%** of data on or over learned frontier
- 3-6 months before failure **27.8%** was over learned frontier
- In the 3 months leading up to failure this had increased to **34.5%**