Supplementary on: A physical-statistical framework on complex mechanical system fault isolation

1 Details on the dataset

The *composite sensors #1–4* measure the original vibrations signals with high frequency. These original vibration signals are then sent to the *resonant demodulators #1–4* through the *cables #1–4* as follows:

- The *resonant demodulator #1* demodulates the vibration signals from *composite sensor #1* into the vibration amplitudes generated by gearbox #1, wheel #1, and bearing #1.
- The *resonant demodulator #2* demodulates the vibration signals from *composite sensor #2* into the vibration amplitudes generated by wheel #2 and bearing #2.
- The *resonant demodulator #3* demodulates the vibration signals from *composite sensor #3* into the vibration amplitudes generated by gearbox #2, wheel #3, and bearing #3.
- The *resonant demodulator #4* demodulates the vibration signals from *composite sensor #4* into the vibration amplitudes generated by wheel #4 and bearing #4.

In addition to vibration amplitudes, the resonant demodulator can obtain the OORs of wheel treads as well. Moreover, the *speed sensor* reads and stores the rotation speeds of shaft #1 and shaft #2. The original readings of vibration signals from *composite sensors #1–4* are not stored to reduce storage burden. Instead, the resonant demodulators resample the vibration amplitudes, the rotating speed, and the OOR measurements every 100 km and send the resampled measurements to the SCADA data center.