Automated quality inspection of high power density gearboxes using end-of-line measurements

Context of the master thesis

In wind energy industry typical gearbox end of line (EOL) tests consist of running static conditions and evaluate temperatures, pressures, vibration values and acoustic noise radiation. For vibration evaluation several accelerometers are used and by performing spectral analysis the excitation originating from the gears are quantified and monitored by setting limits on maximum vibration values. This technique however has some drawbacks: it only investigates a few static conditions and not the complete operating range, it only focusses on gear excitation and not on other parameters such as system dynamics, system dynamics can influence the result very significantly if the static measurement condition is close by a resonance and so on…

Recently more wind turbine OEMs are requesting to perform so called 'runups' during the EOL tests. During this test the torque is kept constant, but the speed is varied from low speed to nominal speed. Using this technique gear excitation frequencies can be monitored on multiple operating conditions, or over the complete runup, but also other assessments can be made, such as evaluating the dynamic behavior of the gearbox, shifts in average gear excitation behavior and so on.

Main topic of the thesis would be to work out several data analysis techniques to evaluate such runups, including, but not limited to: automated operational modal analysis, assessment of average energy from gears, relative assessment of different orders from gears. Using those techniques it should be possible to extract new information from the runups to classify the individual gearboxes and to detect so called outliers which potentially could have a quality issue.

This thesis will be in cooperation with ZF Wind Power and will use real production EOL test data.

Tasks:

- *Literature review of the relevant state-of-the-art techniques to evaluate the acquired data*
- *Investigation of the viability of the techniques mentioned above and facilitating the automatic detection of gearboxes with potential quality issues*

Figure: Test rig on which data was acquired

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