Vysus Group

Fact sheet

Gear dynamics

To correctly design, monitor and troubleshoot gear vibration and gear failures, it is important to consider the entire transmission system from power source to power consumer.

The Engineering Dynamics team of Vysus Group offers more than three decades of practical and theoretical experience in gear dynamics - and state-of-the-art tools for performing gear dynamic studies.

When performing gear calculations, different tools apply for the low frequency range (typically up to 2-3 orders of the shaft speeds) than for the high frequency range (typically gear mesh frequency and higher). In the former case frequency domain methods tend to prevail, while in the latter time marching techniques are more common. In both cases, some type of discretization of the power transmission is involved. Vysus Group uses an in-house developed finite element programme.

Torsional-Lateral-Axial coupling

Due to the nature of geared transmission, any variation in transmitted torque will result in a variation in gear bearing reaction force and vice-versa.

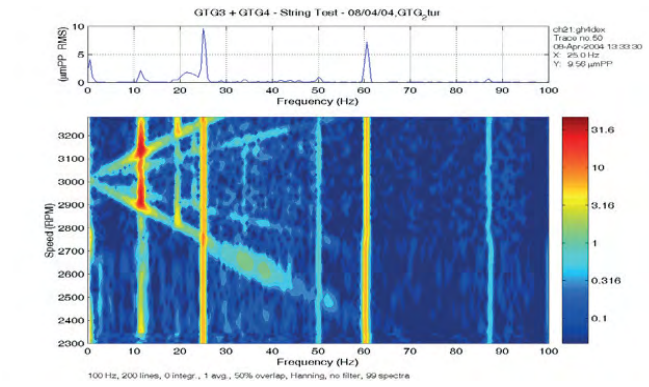
For gears with fluid-film journal bearings, this implies that trip delays are often required to avoid nuisance trips during start-up from shaft relocation caused by the acceleration torque. This implies, that a significant part of the dynamic properties of a geared transmission may be overlooked if the calculation model does not consider torsional and lateral degrees of freedom simultaneously.

For instance, a significant part of the torsional damping in geared transmissions stem from the lateral motion of the gear shafts in their journal bearings. Since bearings change stiffness and damping with applied static load, it follows that the torsional damping may change with transmitted power. This also explains why transmissions with anti-friction bearings tend to have higher amplification factors for the torsional natural frequencies.

Excitation Sources

In a geared transmissions, the excitation frequencies are numerous:

- Driver excitations (engine orders, electrical motor harmonics and noninteger components, power turbine flow excitations, wind turbine load, process control feed back stability, etc.)
- Coupling misalignment
- Gear input and output shaft speed and its harmonics (load line accuracy)
- Mesh frequency and its harmonics
- Break power variations (flow induced torque variations in pumps and compressors, generator power dips and electrical harmonics on grid, propeller load, etc.).



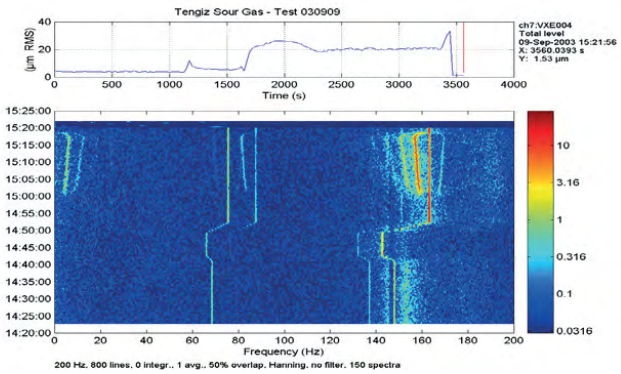
Gear vibrations due to torsional vibrations induced by VSD instability.

For excitation mechanisms with harmonic components, a Campbell interference diagram may help identify conditions where gearbox vibration levels will increase due to resonance with a torsional or lateral natural frequency of the gear in the transmission system.

For transient excitation forces, the load on the gear as function of time will depend on the proximity of natural frequencies and the level of damping.

Non-Linear Gear Dynamics

Backlash is a well-known non-linear phenomenon in gears. However, Vysus Group has been involved in several cases where significant non-linear effects in mesh, bearings and assemblies led to unstable gear vibrations despite positive contact tooth forces in each mesh cycle.



Gear vibrations due to torsional vibrations induced by VSD instability.

Non-linear calculation tools provide a platform for troubleshooting and virtual testing of corrective actions.

Experience and Resources

Vysus Group has gained considerable experience, especially from our work in the oil and gas and power generation industries with a variety of high performance gears.

Vysus Group has in-house, stateof-the-art software for rotor dynamic and bearing dynamic calculations. This enables us to tailor-make the software to solve non-trivial problems. For example, integrated electro-mechanical modelling for transmissions with an electric motor or a generator coupled to a weak grid.

Vysus Group has well-established contacts with leading universities and laboratories around the world. We can therefore assist in organising both component testing and advanced research at the most qualified institutes.

- Rotor Dynamics
- Torsional-Lateral-Axial Coupling
- Mesh Dynamics
- Bearing Coefficient
- Excitation Forces
- Dynamic Stresses
- Telemetry
- Encoders
- Accelerometers
- Displacement Probes
- Strain Gauges
- Process Parameters
- Multichannel Recording and Analysis

Why Vysus Group

- World-leading discipline expertise and personnel
- Global presence and fast response time
- Resources and personnel to manage your asset through design, commissioning, and operation
- Commercial independence from vendors and contractors
- State-of-the-art numerical and analytical tools
- Purpose built methods

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Get in touch

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