



Case-study – Gear teeth cracking

See a cracked tooth directly in the load sharing signal, before vibration CMS picks up anything

Validated with

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Challenge

Gear tooth cracks in planetary gearboxes are the precursor to catastrophic failures, but they are nearly invisible to vibration CMS. The time-varying meshing dynamics of planetary stages mask the subtle spectral changes a cracked tooth produces. By the time vibration detects it, the tooth is broken and secondary damage is underway.

Solution

LumiSens GearUp FBG sensor strip on the ring gear outer surface measures the strain pattern as each planet passes. In a healthy gearbox, every planet produces an identical peak. A cracked tooth reduces local mesh stiffness and the affected planet's peak drops or disappears from the load sharing signal. This is a direct measurement of the mechanical effect.

Result

A cracked tooth is directly visible as a missing or reduced peak in the 0°–720° load sharing plot. The fault signature is unambiguous, no signal processing needed, no thresholds to tune. This enables detection at the earliest possible stage: when stiffness drops, before the tooth breaks off and causes cascading damage to the ring gear, bearings, and carrier.

Why load sharing detects tooth crack earlier

1

Tooth cracks

A fatigue crack at the tooth root reduces the local mesh stiffness of one planet gear.

2

Load redistributes

The cracked tooth carries less load. Adjacent planets compensate — the sharing ratio shifts measurably.

3

Directly visible

The ring gear strain pattern shows the affected planet's peak reduced or missing — visible in a single rotation.

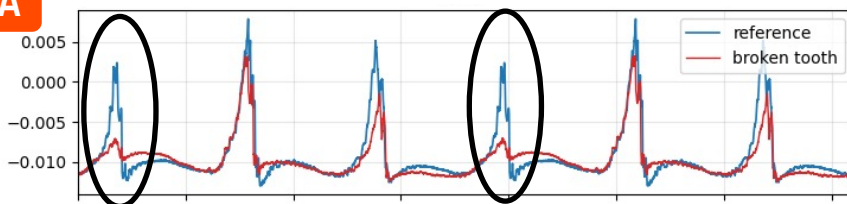
4

Act before failure

Schedule a controlled replacement months before the tooth breaks off and causes cascading gearbox damage.

What it looks like in the data

A



Healthy gearbox: All planet gear peaks are equal and evenly spaced across two full rotations. Symmetrical load sharing.

Cracked tooth detected: One peak is visibly missing; the cracked tooth's reduced stiffness causes it to drop out of the load sharing pattern.

B



Root cause confirmed:

Physical inspection confirms the tooth crack at the exact planet position identified by load sharing signal.