

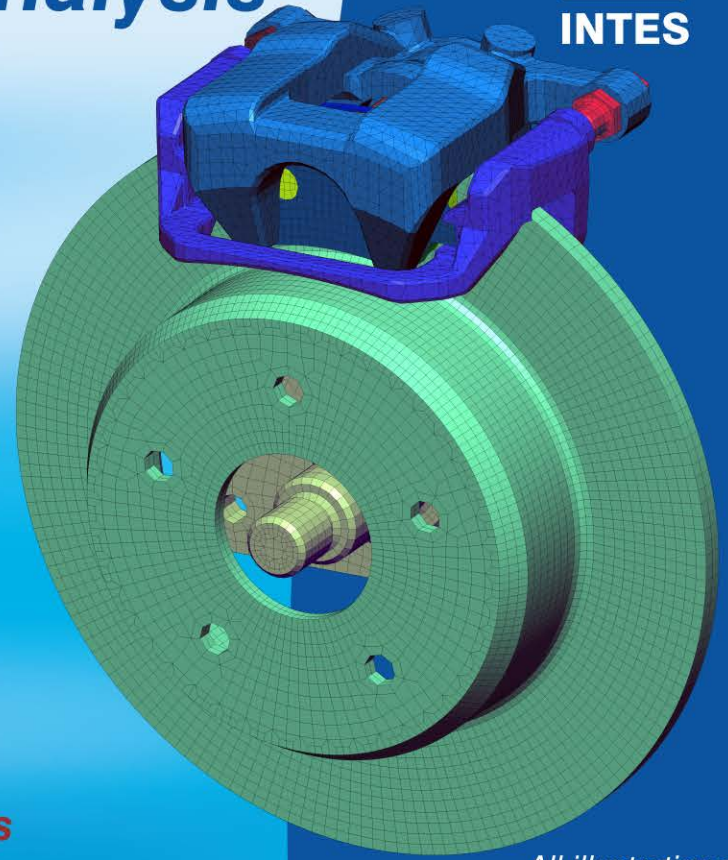
PERMAS

Brake Squeal Analysis



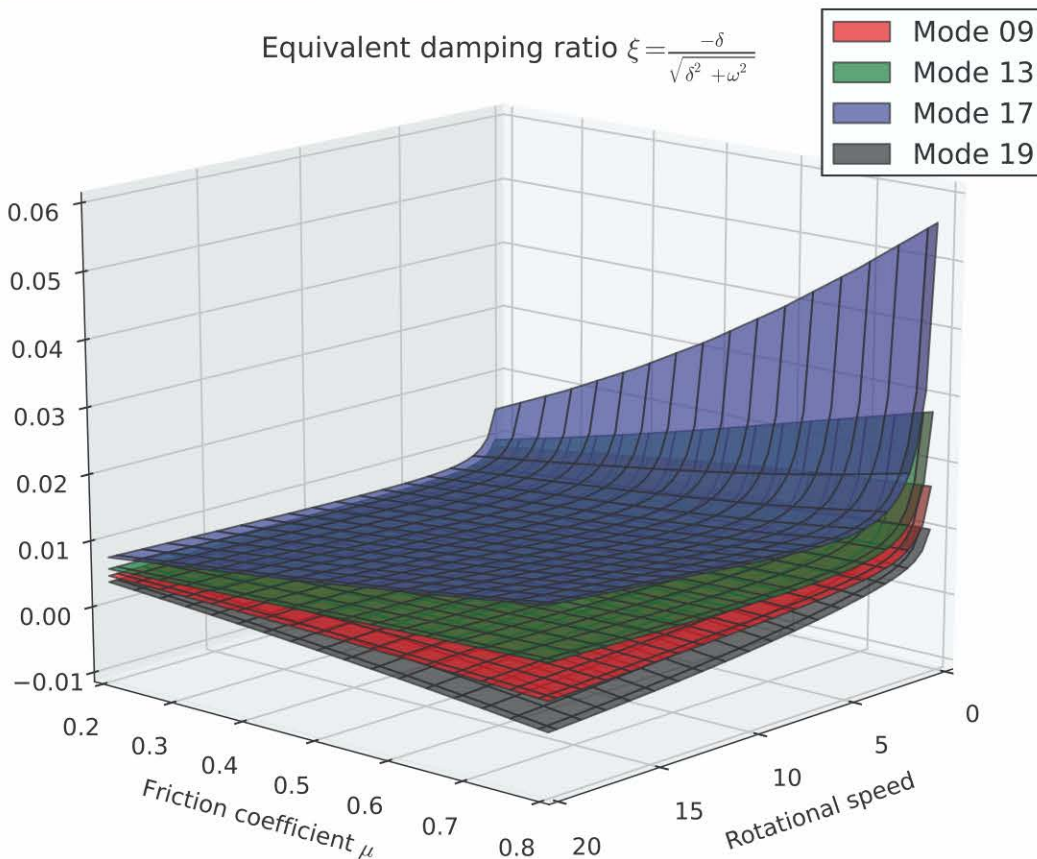
Procedure:

- Based on nonlinear contact analysis with friction under pressure load and rotation
- Real vibration mode analysis under rotation based on contact status
- Complex mode analysis with gyroscopic effects and additional stiffness and damping terms derived from the frictional contact state
- Results for full range of rotational speeds in one computing run
- Easy sampling of frictional coefficients and material properties of pad in one computing run
- Automatic filtering of unstable modes
- Optimization of critical speeds
- Robust design on brake squeal reduction and prevention



All illustrations appear by courtesy of NISSIN KOGYO CO., LTD., Nagano, Japan

$$\text{Equivalent damping ratio } \xi = \frac{-\delta}{\sqrt{\delta^2 + \omega^2}}$$

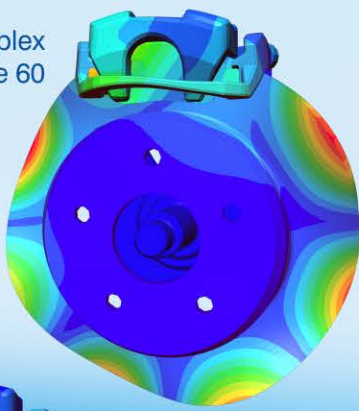


Sampling of frictional coefficient over rotational speeds for four modes

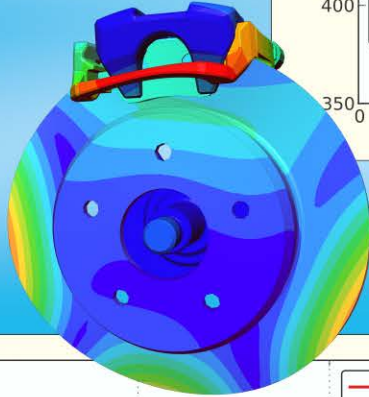
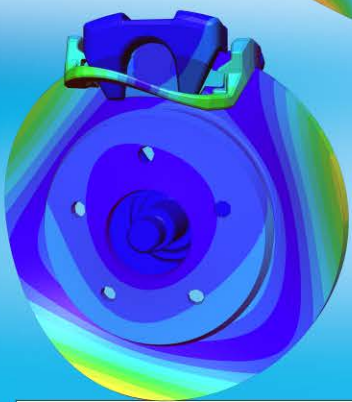
Generated in one computing run

Negative values for equivalent damping ratio denote unstable modes

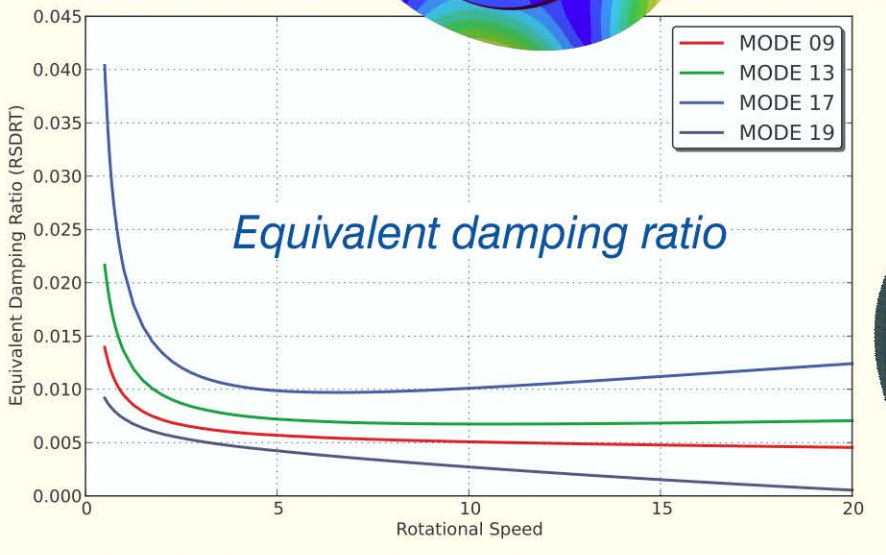
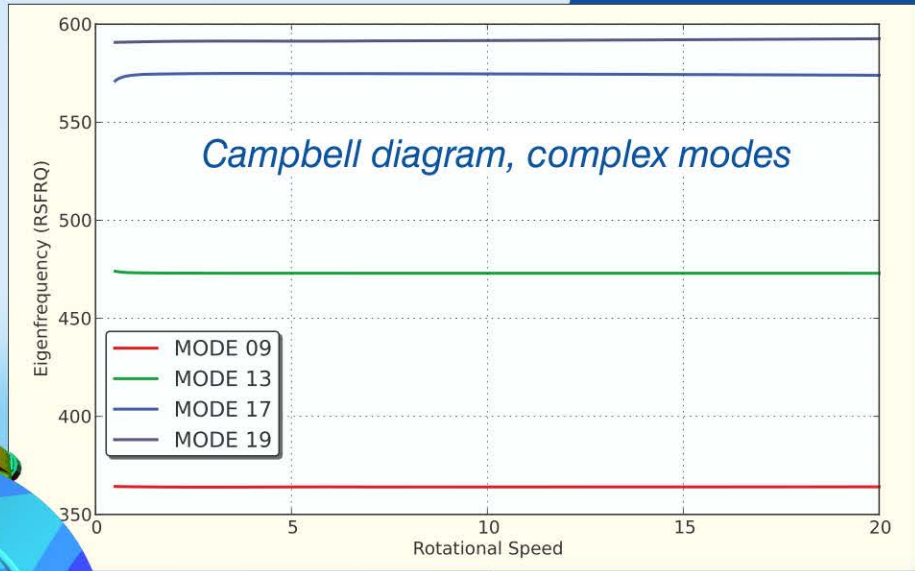
Complex mode shape 60



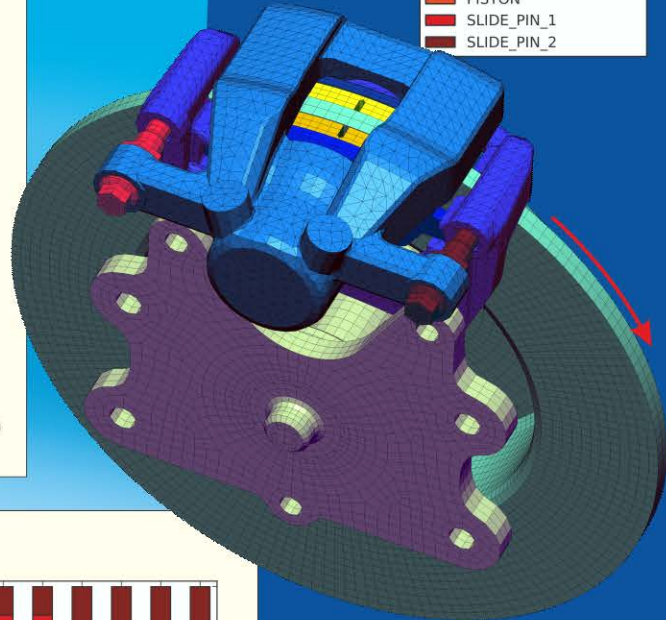
Complex mode shape 41



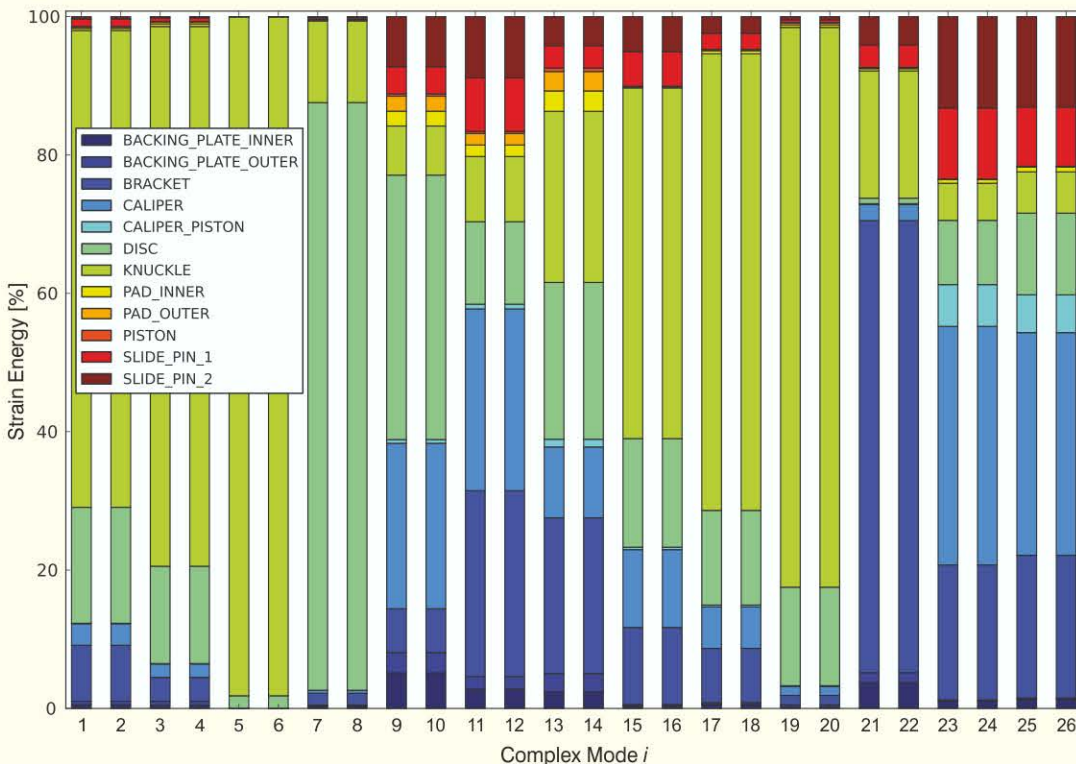
Complex mode shape 34



- BACKING_PLATE_INNER
- BACKING_PLATE_OUTER
- BRACKET
- CALIPER
- CALIPER_PISTON
- DISC
- KNUCKLE
- PAD_INNER
- PAD_OUTER
- PISTON
- SLIDE_PIN_1
- SLIDE_PIN_2



Strain energy distribution



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