PhD Presentation day – 35th cycle
Department of Mechanical and Aerospace Engineering

Non-destructive techniques for damage analysis in standards and hybrid bearings

Materials influence, working conditions, and production processes.

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STATE OF THE ART

Active thermography

- → *Detection of surface defects*
- → *Damage detection and analysis*
- → *Qualitative, not Quantitative: material characterization required*
- → *New Materials*

Process development

- → *Diamond paste is the gold standard for machine tool coatings*
- → *Alternative solutions*
- → *Quality control through vibrations*

Product development

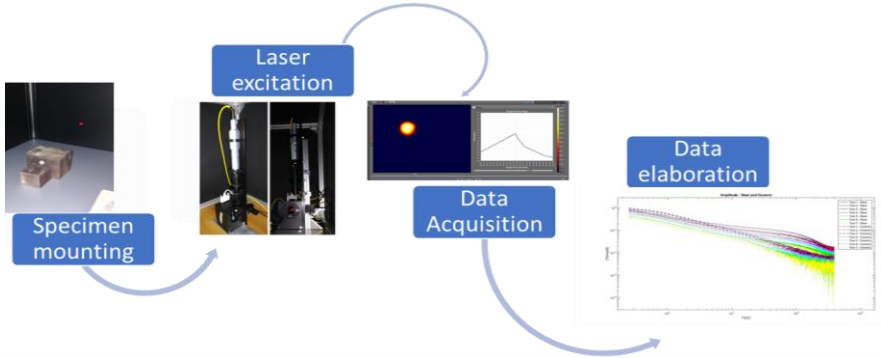
- → *Surface defects induce vibrations and noise*
- → *Worst manufacturing defect*

APPROACH: experimental, analytical and numerical

Active thermography

J-TECH @PoliTO Advanced Joining Technology

Si_3N_4 disks samples:
Material characterization by Active thermography techniques



Process development

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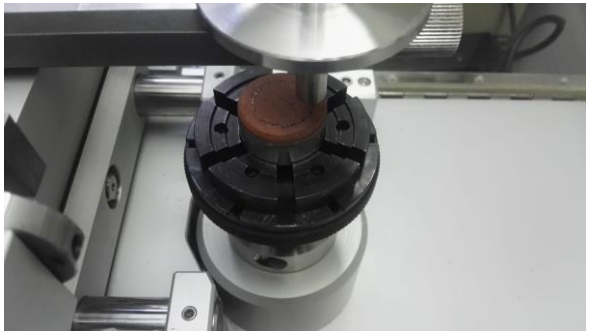
Tribological investigations:
Ceramic and coated steels



Product development

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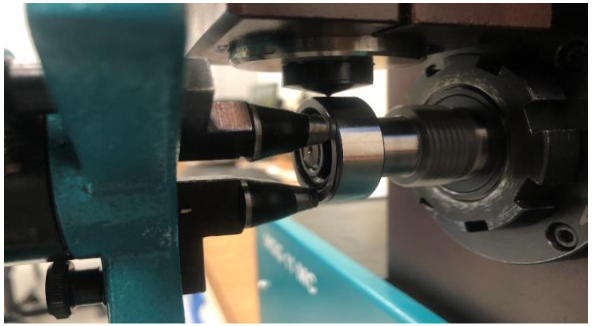
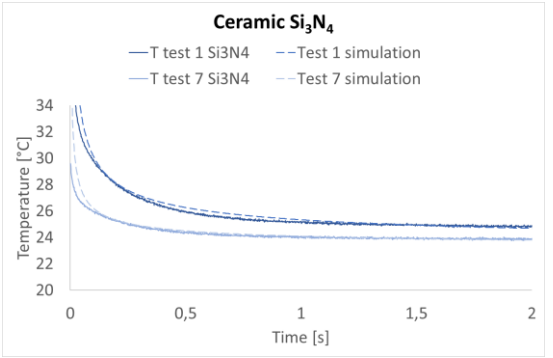
Noiseless bearings:
Analysis of vibrational behavior of defected steel and ceramics balls



EARLY RESULTS

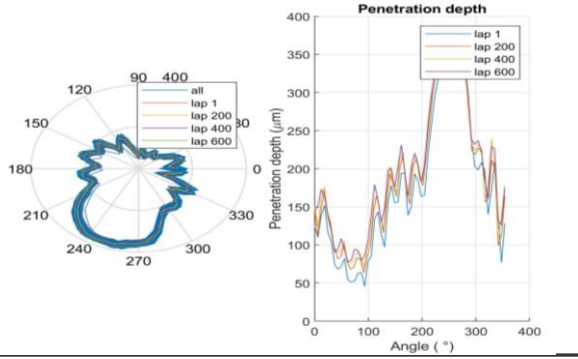
Active thermography

- Free response: Amplitude and phase over frequency spectra
- Analytical model for thermal response in the time domain



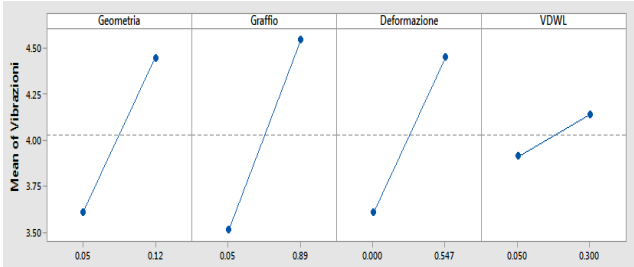
Process development

- Experimental procedure definition
- Comparison of different material for coatings and production process



Product development

- Experimental procedure definition
- Correlation between a limited combination of defects
- Implementation of a statistical model of defects influence on balls



FUTURE STEPS

Active thermography

Experimental
- Material characterization, different ceramic materials and defects

Analytical
- Model in the frequency domain: Thermodynamic heat propagation model and thermal waves comparison (different materials and defects)

Numerical
- Heat propagation model and FEM considering different defects and scales

Process development

Experimental
- Tribological comparison: what is now used vs new coatings

Analytical
- Analytical model

Numerical
- Dynamic simulation of grinding machine

Product development

Experimental
- Vibrational behavior of defected ceramic balls

Statistical and Experimental
- Fatigue model for spheres: production defects and loading conditions

Active thermography

Process development

Product development

Non-destructive control of the production process

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Behavior of defected spheres: improvement and validation of fatigue models

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