



Networking and Brokerage Event Horizon Europe MSCA Staff Exchanges Call 2026

Zero-Defect Micro/Nano Manufacturing for High-Precision Optics and Advanced Devices

16 February 2026

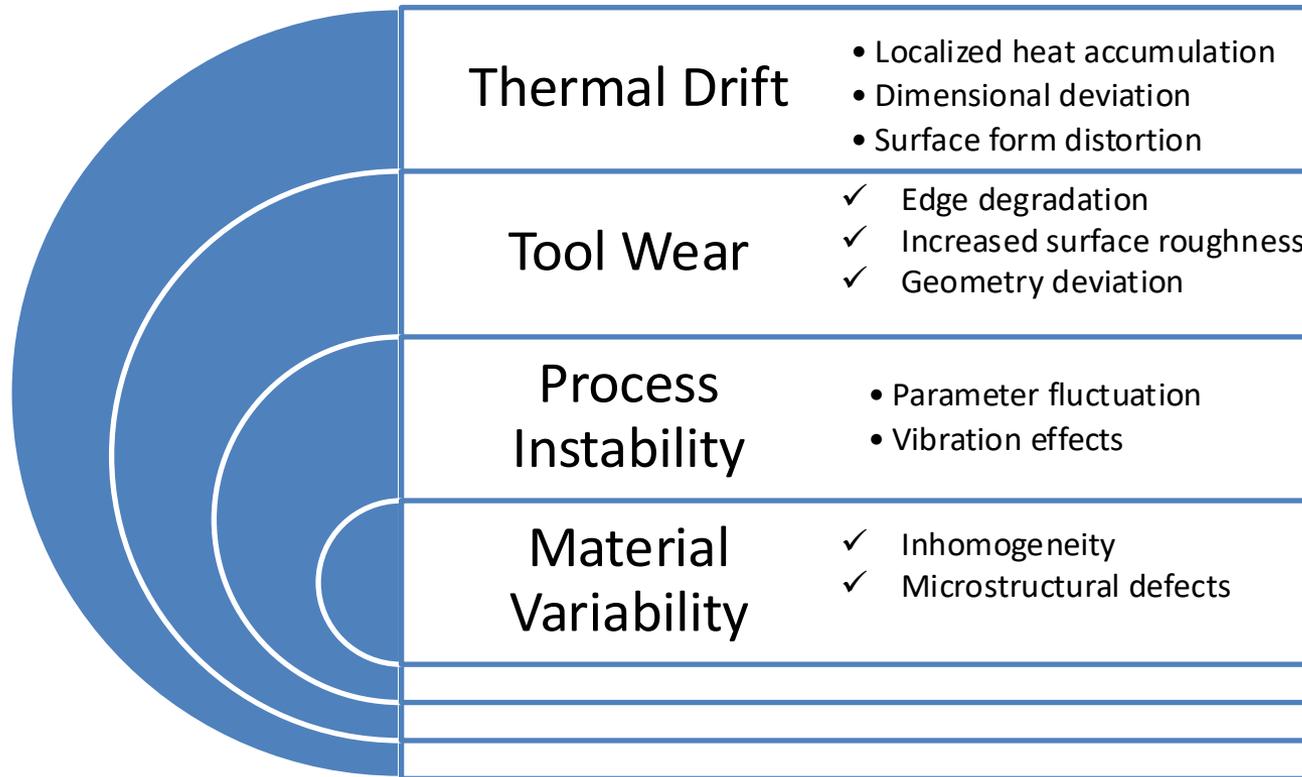
- Name of Presenter: Dr. Neha Khatri
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The Challenge & Opportunity

Towards Zero-Defect Micro/Nano Manufacturing

The Challenge

- ❖ Micro/nano manufacturing demands sub-micron accuracies.
- ❖ Defects arise from Thermal Drift, Tool wear, Process Instability & Material Variability



- ❖ Current approach is Post-process inspection

The Challenge & Opportunity

Towards Zero-Defect Micro/Nano Manufacturing

The Opportunity

EU Strengths

- ❖ Digital Twins & Industry 4.0
- ❖ AI-driven predictive manufacturing
- ❖ Advanced in-line metrology

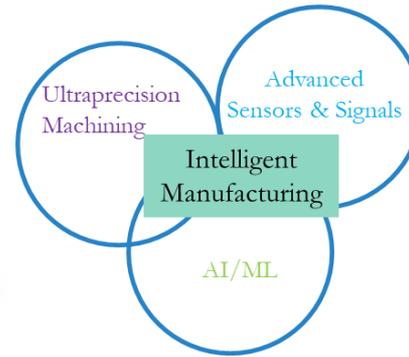
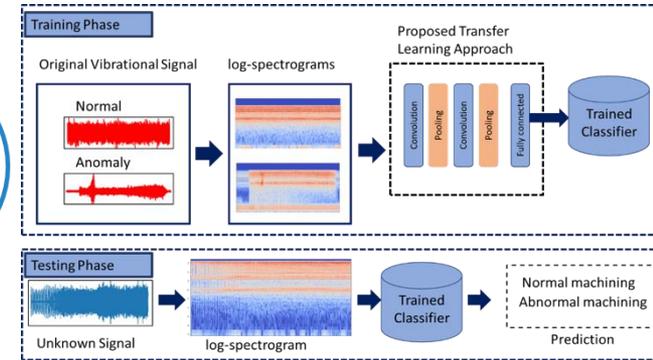
India Strengths

- ❖ Precision optical & microfabrication
- ❖ Cost-effective engineering platforms
- ❖ Applied photonics & device innovation

“Together, we can shift from defect detection to predictive defect prevention, enabling truly zero-defect micro/nano manufacturing.”

Prior Work: Monitoring & Prediction in Advanced Manufacturing

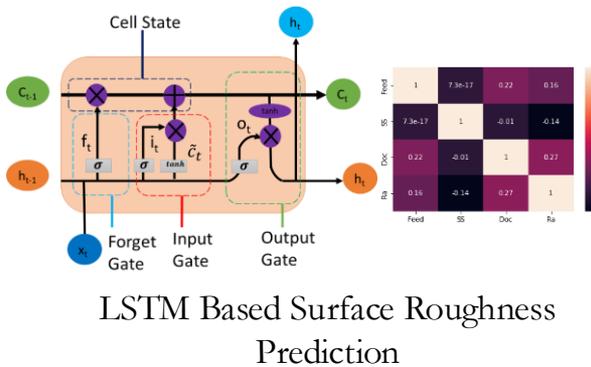
Prediction of anomalies using TL



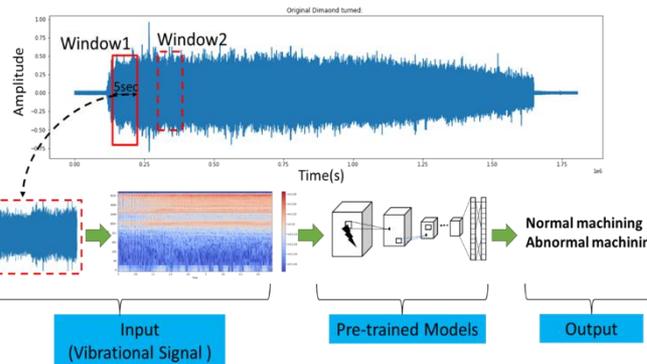
(1) Optical design of a plano-convex lens (2) Diamond machining and characterisation of ZnSe lens

(3) Thermal imaging using a FLIR camera (4) Understanding atomistic origins of ductile-mode in ZnSe

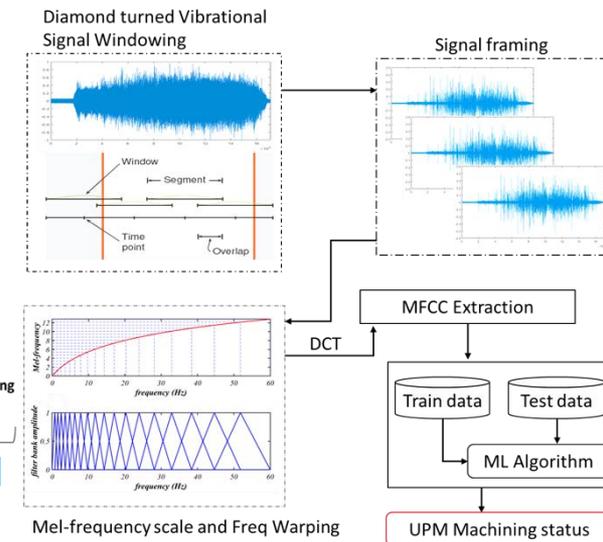
Single-step precision manufacturing of ZnSe lenses for FLIR thermal imaging: From atomic insights to lab-scale fabrication & integration



LSTM Based Surface Roughness Prediction



Detection of Anomalies using CNN



MFCC & ML based UPM Monitoring

References

Khatr, Neha, Sonam Berwal, Bharpoor Singh, Suman Tewary, K. Manjunath, and Saurav Goel. "Single-step precision manufacturing of ZnSe lenses for FLIR thermal imaging: From atomic insights to lab-scale fabrication and integration." *Journal of Manufacturing Processes* 142 (2025): 468-481.

Manjunath, K., et al. "In-process monitoring and prediction of machining status in ultraprecision diamond turning using Mel-frequency cepstral coefficient approach combined with machine learning." *International Journal on Interactive Design and Manufacturing (IJIDeM)* (2025): 1-13.

Manjunath, K., et al. "Monitoring of machining process anomalies in diamond turning of Ti6Al4V alloy using transfer learning-based algorithms." *Computers & Industrial Engineering* 182 (2023): 109359.

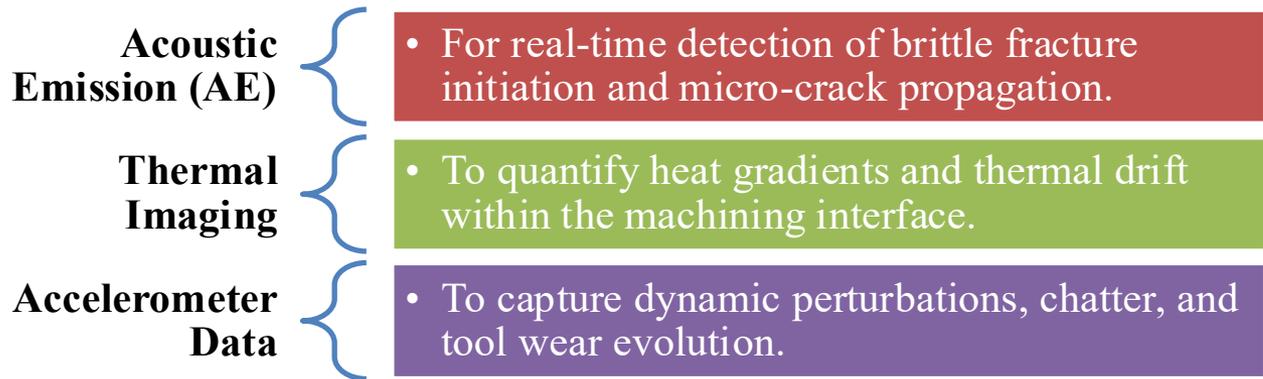
Manjunath, K., et al. "Discrete wavelet transforms analysis of vibration signals for correlating tool wear in diamond turning of additive manufactured Ti-6Al-4V alloy." *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture* 238, no. 10 (2024): 1568-1575.

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Project Description

- ❖ **Aim:** Development of a **multi-sensor integrated digital twin framework** for zero-defect micro/nano manufacturing by combining acoustic emission, thermal imaging, and dynamic vibration analytics.
- ❖ At micro and nano scales, defects often originate from brittle fracture events, localized thermal gradients, and dynamic perturbations in the machining zone. Conventional monitoring systems capture only isolated parameters, limiting predictive capability.

Our approach integrates:



The digital twin will synchronize real-time input with predictive machine learning models to:

- ❖ Identify early-stage defect signatures
- ❖ Resolve multi-scale thermo-mechanical interactions
- ❖ Forecast tool degradation
- ❖ Enable adaptive, closed-loop process correction

Profile of the partners sought

Saurav Goel, Professor
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Professor **Saurav Goel** is a Professor of Manufacturing in the School of Engineering and Design at London South Bank University, specialising in precision and digitalised manufacturing, surface engineering, and advanced materials. He leads research that combines experimental processing with modelling to improve manufacturing processes and technologies, and collaborates widely across industry and academia. His work has produced extensive journal publications and contributes to sustainable, data-driven engineering solutions.