

Editorial

# Machine Tools, Advanced Manufacturing, and Precision Manufacturing

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Modern industries impose numerous challenges on manufacturing technologies and systems due to stringent quality requirements, the adoption of difficult-to-machine materials, high demands on miniaturization, mass customization, high productivity, and sustainability targets. Addressing these challenges requires a holistic approach that integrates advanced manufacturing processes, equipment, measurement and data-driven control methods.

In this context, this Special Issue provides a focused forum for research that advances the domains of machining processes, precision engineering, intelligent monitoring, digitalization, and additive manufacturing. It comprises thirteen articles spanning the topics: machining efficiency and toolpath planning, machine tool design and calibration, tool performance and wear prediction, additive manufacturing and post-processing, and data-enabled production logistics. Collectively, these papers emphasize improving accuracy and surface integrity while simultaneously increasing productivity and robustness through better modelling, sensing, and decision support.

In machining science and machine-tool performance, productivity improvements are pursued not only in terms of higher cutting speeds but also through smoother trajectories, improved motion consistency, and reduced non-productive time [1,2]. In addition to quality–time tradeoffs, these strategies are motivated by energy efficiency and tool-life considerations, since smoother motion profiles can reduce peak loads, vibration, and heat accumulation, thereby providing better surface integrity and dimensional consistency.

Precision is reinforced through systematic calibration, compensation, and measurement practices, highlighting the role of metrology and error management in achieving reliable micron-level performance. Recent studies highlight that accuracy is constrained by dynamic and thermally induced errors, in addition to static geometric deviations, motivating new calibration strategies that better represent real operating conditions. In parallel, advances in volumetric error modelling and prediction for multi-axis CNC systems support earlier-stage error detection and more effective compensation throughout the working volume [3,4].

Tool life and process reliability are now being treated as predictive tasks, combining sensor signals with machine learning-based approaches to anticipate degradation and maintain consistent output quality [5,6]. These approaches are particularly valuable in high-mix environments, where variability in materials, geometry, and cutting conditions makes fixed tool change intervals inefficient. By enabling condition-based maintenance and early anomaly detection, predictive tool health models can reduce scrap and downtime while supporting stable surface integrity and dimensional accuracy.



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Additive manufacturing contributions have grown from just the feasibility demonstrations toward increased quality and application readiness, where property prediction, post-processing strategies, and geometric verification are essential for dependable deployment [7,8]. Accordingly, there is an increased research focus on linking process parameters to repeatable dimensional accuracy and performance, supported by metrology-driven verification that reduce uncertainties.

Finally, contributions connecting manufacturing engineering with systems-level decision-making and mechanism innovation are becoming increasingly important. For example, conceptual frameworks for operations management and Industry 4.0-oriented supply planning highlight the growing role of traceable, responsive logistics supported by data and modelling [9]. In parallel, mechanism and transmission innovations relevant to machine tools and automation continue to be explored through mathematical modelling and design-led evaluation [10].

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#### List of Contributions

1. Leroy, C.; Lavernhe, S.; Rivière-Lorphèvre, É. Hermite Quartic Splines for Smoothing and Sampling a Roughing Curvilinear Spiral Toolpath. *Appl. Sci.* **2024**, *14*, 7492. <https://doi.org/10.3390/app14177492>.
2. Felhő, C.; Namboodri, T. Statistical Analysis of Cutting Force and Vibration in Turning X5CrNi18-10 Steel. *Appl. Sci.* **2024**, *15*, 54. <https://doi.org/10.3390/app15010054>.
3. Tabakovic, S.; Zeljkovic, M.; Zivanovic, S.; Budimir, A.; Dimic, Z.; Kosarac, A. Calibration of a Hybrid Machine Tool from the Point of View of Positioning Accuracy. *Appl. Sci.* **2024**, *14*, 5275. <https://doi.org/10.3390/app14125275>.
4. Galkiewicz, J.; Janus-Galkiewicz, U. A Machine Tool for Boring of the Diesel Engine Block Counterbore. *Appl. Sci.* **2025**, *15*, 9143. <https://doi.org/10.3390/app15169143>.
5. Osan, A.; Banica, M. Comparison of the Wear of Toroidal and Spherical Cutters in Milling and the Impact of Corrosion. *Appl. Sci.* **2025**, *15*, 8403. <https://doi.org/10.3390/app15158403>.
6. Charalampous, P. Performance Investigation of Coated Carbide Tools in Milling Procedures. *Appl. Sci.* **2025**, *15*, 3765. <https://doi.org/10.3390/app15073765>.
7. Lin, S.Y.; Hsieh, C.J. Construction of a cutting-tool wear prediction model through ensemble learning. *Appl. Sci.* **2024**, *14*, 3811. <https://doi.org/10.3390/app14093811>.
8. Meana, V.; Zapico, P.; Cuesta, E.; Giganto, S.; Meana, L.; Martínez-Pellitero, S. Additive Manufacturing of Ceramic Reference Spheres by Stereolithography (SLA). *Appl. Sci.* **2024**, *14*, 7530. <https://doi.org/10.3390/app14177530>.
9. Bellocchio, A.M.; Ciancio, E.; Ciraolo, L.; Barbera, S.; Nucera, R. Three-Dimensional Printed Attachments: Analysis of Reproduction Accuracy Compared to Traditional Attachments. *Appl. Sci.* **2024**, *14*, 3837. <https://doi.org/10.3390/app14093837>.
10. Mantalas, E.M.; Sagiias, V.D.; Zacharia, P.; Stergiou, C.I. Neuro-Fuzzy Model Evaluation for Enhanced Prediction of Mechanical Properties in AM Specimens. *Appl. Sci.* **2024**, *15*, 7. <https://doi.org/10.3390/app15010007>.
11. Rivolta, B.; Gerosa, R.; Panzeri, D. Selective Laser-Melted Alloy 625: Optimization of Stress-Relieving and Aging Treatments. *Appl. Sci.* **2025**, *15*, 5441. <https://doi.org/10.3390/app15105441>.
12. Pekarčíková, M.; Kliment, M.; Kronová, J.; Trebuňa, P.; Hovana, A. Simulation-Based Optimization of Material Supply in Automotive Production Using RTLS Data. *Appl. Sci.* **2025**, *15*, 9102. <https://doi.org/10.3390/app15169102>.

13. Haragâș, S.; Ninacs, R.; Buiga, O.; Tudose, L.; Haragâș, A.; Sas-Boca, I.M.; Cristea, F.A. An attempt to establish a mathematical model for an unconventional worm gear with bearings. *Appl. Sci.* **2024**, *14*, 10833. <https://doi.org/10.3390/app142310833>.

## References

1. Busatto, M.; Caprio, L.; Cazzador, M.; Previtali, B. Compensating thermal expansion via tool path correction during fusion laser cutting of Al5754. *Int. J. Adv. Manuf. Technol.* **2025**, *141*, 4985–5004. [[CrossRef](#)]
2. Taifa, I.; Vhora, T. Cycle time reduction for productivity improvement in the manufacturing industry. *J. Ind. Eng. Manag. Stud.* **2019**, *6*, 147–164.
3. Abir, J.; Longo, S.; Morantz, P.; Shore, P. Virtual metrology frame technique for improving dynamic performance of a small size machine tool. *Precis. Eng.* **2017**, *48*, 24–31. [[CrossRef](#)]
4. Wu, H.; Li, X.; Sun, F.; Zhao, Y. A status review of volumetric positioning accuracy prediction theory and static accuracy design method for multi-axis CNC machine tools. *Int. J. Adv. Manuf. Technol.* **2022**, *122*, 2139–2159. [[CrossRef](#)]
5. Cheng, M.; Jiao, L.; Yan, P.; Jiang, H.; Wang, R.; Qiu, T.; Wang, X. Intelligent tool wear monitoring and multi-step prediction based on deep learning model. *J. Manuf. Syst.* **2022**, *62*, 286–300. [[CrossRef](#)]
6. Kim, G.; Yang, S.M.; Kim, D.M.; Kim, S.; Choi, J.G.; Ku, M.; Lim, S.; Park, H.W. Bayesian-based uncertainty-aware tool-wear prediction model in end-milling process of titanium alloy. *Appl. Soft Comput.* **2023**, *148*, 110922. [[CrossRef](#)]
7. Akbari, P.; Zamani, M.; Mostafaei, A. Machine learning prediction of mechanical properties in metal additive manufacturing. *Addit. Manuf.* **2024**, *91*, 104320. [[CrossRef](#)]
8. Laleh, M.; Sadeghi, E.; Revilla, R.I.; Chao, Q.; Haghdadadi, N.; Hughes, A.E.; Xu, W.; De Graeve, I.; Qian, M.; Gibson, I.; et al. Heat treatment for metal additive manufacturing. *Progress Mater. Sci.* **2023**, *133*, 101051. [[CrossRef](#)]
9. Reyes, J.; Mula, J.; Díaz-Madroño, M. Development of a conceptual model for lean supply chain planning in industry 4.0: Multidimensional analysis for operations management. *Prod. Plan. Control* **2023**, *34*, 1209–1224. [[CrossRef](#)]
10. Haragâș, S.; Ninacs, R.; Buiga, O.; Tudose, L.; Haragâș, A.; Sas-Boca, I.M.; Cristea, F.A. An attempt to establish a mathematical model for an unconventional worm gear with bearings. *Appl. Sci.* **2024**, *14*, 10833. [[CrossRef](#)]

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