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Computer-Aided Design in Mechanical Engineering

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Modern mechanical engineering relies on computer-aided design (CAD) systems, which have evolved far beyond traditional drafting tools into advanced digital platforms integrating 3D modeling, finite element analysis (FEA), parametric design, and manufacturing technologies. This evolution is driven by industrial demand for shorter development cycles, a reduced time-to-market, lower production costs, and improved structural and material efficiency. CAD systems also foster innovation through their integration with virtual and augmented reality, artificial intelligence, and additive manufacturing. These technologies enable immersive and collaborative design environments, AI-driven generative design, automated error detection, and the fabrication of complex and customized structures previously impossible to manufacture. This Special Issue presents the current state-of-the-art in mechanical engineering and identifies three major research directions. The first focuses on geometric accuracy, advanced modeling, and the integration of geometric dimensioning and tolerancing (GD&T) with additive manufacturing (AM). The second explores advanced generative methods, including AI-enhanced and human-guided topology optimization, and parametric algorithms for customized structures. The third focuses on simulation fidelity and dynamic validation, emphasizing the importance of combining computational and experimental methods to ensure that digital simulations accurately reproduce real mechanical behavior. These advances are shaping a new generation of smart, efficient, and sustainable engineering design methodologies.



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