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REVIEW ON ADVANCEMENTS IN HYDROFORMING USING MACHINE LEARNING

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This paper reviews the integration of artificial intelligence and machine learning (AI/ML) in hydroforming to optimize process parameters and predict material deformation. Leveraging neural networks and physics-informed neural networks (PINNs), the approach significantly enhances accuracy, reduces defects such as wrinkling and thinning, and reduces the need for trial runs. PINNs incorporate fluid dynamics and material behavior to predict final part geometry, enabling improved control and precision over traditional finite element analysis (FEA). By refining key variables—including input pressure, material thickness, temperature, and forming time—this method supports adaptive control for complex shapes and boosts computational efficiency. The integration of AI/ML promotes scalable, cost-effective and high-precision manufacturing of lightweight, high-strength components, particularly in the automotive and aerospace sectors. Key findings emphasize notable process optimization and advanced deformation prediction, opening avenues for future innovations in adaptive control systems and expanded applications across the recent state-of-the-art materials.

Keywords: Hydroforming, intricate shapes, lightweight, water pressure, accuracy, industrial applications.