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ENSURING ACCURACY IN THE DESIGN OF LAYOUTS AND THE USE OF MOBILE PORTABLE MACHINES WITH AN AGGREGATE-MODULAR CONSTRUCTION

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Abstract. To explore the principles and methodologies for ensuring accuracy in the design of layouts and the use of mobile portable machines with an aggregate-modular construction. The study highlights the importance of modular design in enhancing efficiency, adaptability, and precision in

industrial applications. Key challenges and solutions related to the structural integrity and integration of advanced technologies are discussed.
Keywords: modular construction, accuracy, mobile portable machines, aggregate-modular design, precision engineering.

Introduction

Topicality

In modern industrial and manufacturing processes, the need for flexible and precise machine tools has grown significantly. Mobile portable machines with an aggregate-modular construction offer a practical solution by allowing for reconfiguration and adaptability. However, ensuring accuracy in their design and application remains a challenge that requires a combination of structural analysis, advanced measurement technologies, and innovative engineering solutions.

The significance of this study lies in the increasing demand for modular and portable machine tools across various industries, including construction, aerospace, and heavy engineering. As industries shift towards more adaptive manufacturing systems, the accuracy of modular machines becomes crucial for maintaining product quality and operational efficiency.

The object of research is the structural and functional characteristics of mobile portable machines with an aggregate-modular design.

The subjects of research are principles, methodologies and technological solutions used to ensure accuracy in the design and application of modular machines.

The goal is to develop and analyze strategies for improving the accuracy and reliability of mobile portable machines with an aggregate-modular construction.

The tasks of the research are:

1. To examine the principles of modular machine design and their impact on precision.
2. To analyze structural configurations and their influence on machine performance.
3. To explore the integration of advanced measurement and control technologies.
4. To evaluate case studies demonstrating the efficiency of modular portable machines.
5. To propose recommendations for improving accuracy and operational efficiency.

The novelty This study provides a comprehensive analysis of aggregate-modular machine design from an accuracy perspective, integrating insights from various engineering disciplines. It proposes new approaches to optimizing modular layouts using advanced sensing and alignment technologies.

Methodology

The research is based on a combination of theoretical analysis and practical case studies. Structural modeling and simulation techniques are employed to evaluate machine accuracy. Empirical data from industrial applications of modular machines are analyzed to assess real-world performance. The study also incorporates insights from recent advancements in precision engineering and automation.

Finite element analysis (FEA) is utilized to simulate the mechanical behavior of modular components under operational loads. This method helps in identifying potential deformations and misalignments that could affect precision. The results from FEA simulations are compared with experimental data obtained from real-world applications of portable modular machines [1].

Furthermore, laser tracking systems and coordinate measuring machines (CMM) are employed to assess the accuracy of assembled modular units. These technologies enable high-precision measurements, ensuring that modular components maintain alignment and structural integrity during operation. The study integrates data from previous research on precision measurement techniques in modular manufacturing [2].

A comparative analysis of different modular machine configurations is conducted to determine the optimal layout for accuracy and efficiency. Various case studies from manufacturing industries utilizing aggregate-modular designs are examined, providing practical insights into best practices and challenges faced in the implementation of these technologies [3].

Ensuring accuracy in the design of layouts and the use of mobile portable machines with an aggregate-modular construction is crucial for enhancing performance, flexibility and efficiency in manufacturing. The study explores various configurations of mobile machine tools, analyzing their structural composition and operational adaptability. By implementing aggregate-modular principles, these machines achieve higher precision and reconfigurability, allowing for seamless integration into diverse production environments. The research highlights the significance of optimized layouts in maintaining machining accuracy, minimizing errors, and improving overall functionality. This approach contributes to the advancement of mobile machining systems, ensuring reliability and efficiency in industrial applications [4].

Discussion. This study aligns with the core principles of the New European Research Paradigm by emphasizing sustainability, prioritizing human-centric methodologies and driving impactful, interdisciplinary advancements in modular engineering and precision technology:

Sustainability (economic-ecological-social):

The modular construction enhances resource utilization by minimizing waste and reducing energy consumption. This approach ensures both financial

viability and environmental sustainability, fostering long-term industrial efficiency.

Human centered - Wellbeing:

The engineering design of these machines emphasizes adaptability to user needs, prioritizing ergonomic features, safety measures, and operational convenience. These enhancements contribute to improving workplace conditions and boosting overall productivity.

Impact orientated - Multi-agent/Sector/Disciplinary Co-Creation:

This research incorporates knowledge from multiple fields, promoting synergistic efforts between different industrial sectors. By fostering multi-agent cooperation, the study enhances precision, scalability, and real-world effectiveness of modular machinery.

Conclusions. Ensuring accuracy in mobile portable machines with an aggregate-modular design requires a holistic approach encompassing structural optimization, advanced measurement technologies, and adaptive control systems. By refining modular layouts and incorporating real-time precision monitoring, industries can enhance the efficiency and reliability of portable machine tools.

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