

METHOD FOR OBJECT CLASSIFICATION BASED ON FUNCTIONAL CHARACTERISTICS USING MULTILEVEL SEMANTIC SEGMENTATION

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This paper presents a novel method for object classification that integrates functional characteristics with multilevel semantic segmentation. The approach is particularly relevant for applications involving technical systems, industrial components, and complex machine assemblies where traditional geometric or visual classification proves insufficient.

The core of the method lies in a hierarchical semantic segmentation model that processes object data across multiple abstraction levels. At each level, the model extracts functional features—such as movement type, energy flow, or interaction patterns—and associates them with semantic labels. These labels are then combined through a fusion mechanism to produce a classification output that reflects the object's role and functional behavior.

The method leverages deep convolutional neural networks (CNNs) for segmentation and employs an attention mechanism to focus on contextually significant features. It supports both static and dynamic analysis, allowing classification of objects based not only on appearance but also on their functional use in context.

Experimental validation on a dataset of mechanical subsystems demonstrated improved accuracy and interpretability compared to baseline classification models. The approach is adaptable to various domains including digital twins, industrial diagnostics, and smart manufacturing environments.

The proposed method enhances object classification by incorporating functional characteristics through multilevel semantic segmentation. It improves accuracy and contextual understanding, making it suitable for intelligent diagnostics and advanced technical systems.

References

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