

Comparative Analysis of Choquet Integral and Takagi–Sugeno for Ensemble Fusion in Deepfake Detection

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Abstract:

Deepfakes pose a significant threat to digital trust and online media authenticity. Although deep learning-based classifiers such as Xception and EfficientNet achieve strong detection performance, their reliability is limited when confronted with unseen manipulations or degraded video quality. Ensemble fusion improves robustness by combining multiple classifiers, but the choice of fusion mechanism greatly influences performance. This paper presents a comparative analysis of the Choquet Integral (CI) and Takagi Sugeno Kang (TSK) fuzzy systems for decision-level fusion in deepfake detection. CNN outputs from Xception, EfficientNet and ResNet were fused using both methods on benchmark datasets including DFDC, Celeb-DF and DeepfakeTIMIT. Results show that CI achieves superior accuracy and robustness (up to 92.3% accuracy on DFDC) by modeling classifier interactions, while TSK achieves competitive performance (89.6% accuracy) with the advantage of interpretable fuzzy rules. The trade-offs between accuracy, complexity and explainability are analyzed, providing practical guidance for the design of hybrid deepfake detection frameworks.

Keywords:

Choquet integral, Deepfake detection, ensemble fusion, explainable AI, fuzzy systems, Takagi–Sugeno fuzzy model.