

SMART-IQA: Swin Multi-scale Attention-guided Regression Transformer for Blind Image Quality Assessment

Nuoyan Chen

School of Computer Science
Shanghai Jiao Tong University
Shanghai, China
nuoyanchen@sjtu.edu.cn

Abstract—Blind image quality assessment (BIQA) for authentically distorted images remains challenging due to diverse content variations and complex distortion patterns. While the original HyperIQA employs a self-adaptive hyper network with ResNet-50 backbone, it struggles to capture fine-grained multi-scale features and global contextual information. We propose SMART-IQA, a Swin Transformer-based framework that integrates multi-scale spatial features with attention-guided fusion for enhanced quality prediction. By replacing the CNN backbone with Swin Transformer and preserving spatial information through adaptive pooling, our method achieves superior feature representation. A novel channel attention mechanism dynamically weights multi-scale features according to image content and distortion characteristics. Extensive experiments on KonIQ-10k demonstrate that SMART-IQA achieves state-of-the-art performance with 0.9378 SRCC, outperforming existing methods including the original HyperIQA by 3.08 percent. Cross-dataset evaluations further validate the strong generalization capability of our approach.

Index Terms—Image Quality Assessment, Swin Transformer, Multi-scale Feature Fusion, Attention Mechanism, Hyper Network, Deep Learning

I. INTRODUCTION

Image quality assessment (IQA) aims to automatically predict image quality in a manner consistent with human perception. Blind IQA (BIQA), which operates without access to reference images, remains particularly challenging for authentically distorted images captured in the wild. Unlike synthetically distorted images with controlled, uniform distortions, real-world images exhibit diverse content variations and complex, non-uniform distortion patterns that pose significant challenges to existing methods.

Recent advances in deep learning have shown promising results for BIQA. HyperIQA [?] introduced a self-adaptive hyper network architecture that dynamically generates quality prediction weights based on image content, achieving strong performance on authentic distortion datasets. However, its ResNet-50 backbone has limitations in capturing global context and fine-grained multi-scale features, which are crucial for assessing diverse real-world distortions.

In this work, we propose SMART-IQA (Swin Multi-scale Attention-guided Regression Transformer for Image Quality

Assessment), which integrates Swin Transformer’s hierarchical vision architecture with multi-scale attention-guided feature fusion. Our key contributions are: (1) replacing the CNN backbone with Swin Transformer to capture richer semantic and spatial features through window-based self-attention, (2) preserving spatial information by adaptively pooling multi-scale features to 7x7 resolution instead of aggressive compression, (3) introducing a channel attention mechanism that dynamically weights different scales according to image content and distortion characteristics, and (4) incorporating dropout regularization to enhance generalization. Extensive experiments demonstrate that SMART-IQA achieves state-of-the-art performance on KonIQ-10k with 0.9378 SRCC, surpassing the original HyperIQA by 3.08% and other competing methods.

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Table Head	Table Column Head		
	Table column subhead	Subhead	Subhead
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ACKNOWLEDGMENT

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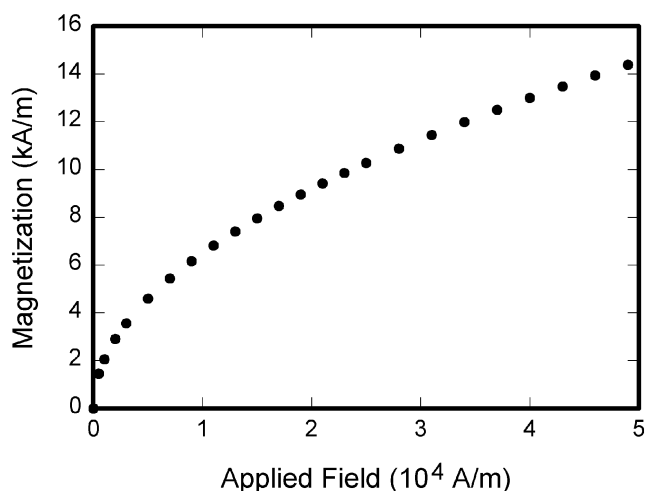


Fig. 1. Example of a figure caption.

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REFERENCES

- [1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529–551, April 1955.
- [2] J. Clerk Maxwell, *A Treatise on Electricity and Magnetism*, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
- [3] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in *Magnetism*, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
- [4] K. Elissa, “Title of paper if known,” unpublished.
- [5] R. Nicole, “Title of paper with only first word capitalized,” *J. Name Stand. Abbrev.*, in press.
- [6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” *IEEE Transl. J. Magn. Japan*, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetism Japan, p. 301, 1982].

- [7] M. Young, *The Technical Writer's Handbook*. Mill Valley, CA: University Science, 1989.
- [8] D. P. Kingma and M. Welling, "Auto-encoding variational Bayes," 2013, arXiv:1312.6114. [Online]. Available: <https://arxiv.org/abs/1312.6114>
- [9] S. Liu, "Wi-Fi Energy Detection Testbed (12MTC)," 2023, gitHub repository. [Online]. Available: <https://github.com/liustone99/Wi-Fi-Energy-Detection-Testbed-12MTC>
- [10] "Treatment episode data set: discharges (TEDS-D): concatenated, 2006 to 2009." U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies, August, 2013, DOI:10.3886/ICPSR30122.v2
- [11] K. Eves and J. Valasek, "Adaptive control for singularly perturbed systems examples," Code Ocean, Aug. 2023. [Online]. Available: <https://codeocean.com/capsule/4989235/tree>

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