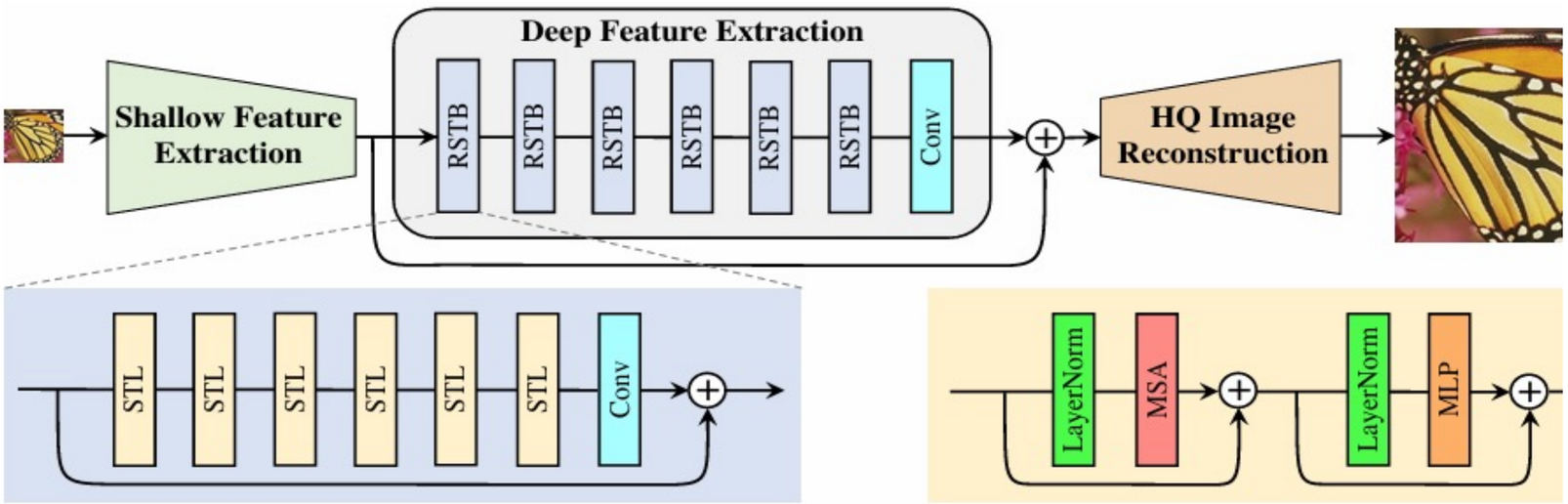
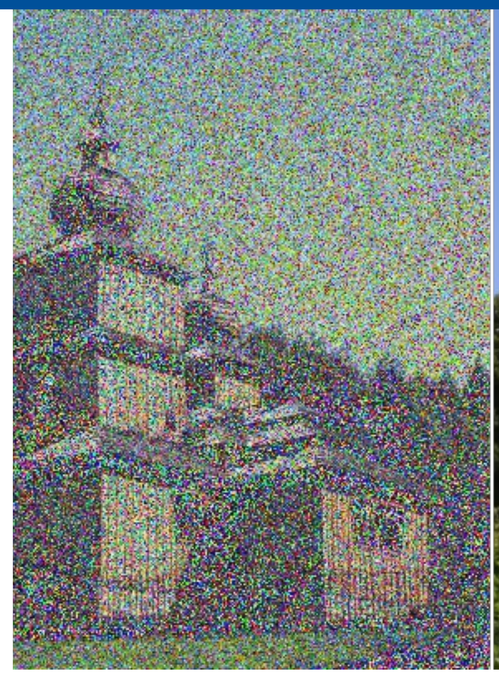
AUTONOMY RESEARCH CENTER FOR STEAHM

Human-Machine Teamwork
With Explainable AI

Image Restoration Using Deep Learning





Synopsis

- Using deep learning techniques to remove noise (visual distortion) from images for clearer, more accurate visuals.
- Neural networks are trained to identify and reduce noise without losing essential image details.
- Applications in medical imaging, satellite imagery, photography, and more.

Research Objective

- To create deep learning models that minimize noise in images while maintaining crucial details.
- Ensure that denoising models are generalizable across different types of images

Research Approach

- Implement a transformer architecture tailored for image denoising tasks, leveraging self-attention mechanisms for capturing long-range pixel relationships.
- Train the model on large-scale datasets of noisy and clean images, optimizing for image restoration and noise reduction.
- Use standard evaluation metrics such as PSNR (Peak Signal-to-Noise Ratio) and SSIM (Structural Similarity Index) to benchmark the model's performance against traditional methods like CNNs and autoencoders.

Research Results and Products

- Development of a transformer-based model that significantly reduces noise in images.
- Performance evaluation demonstrates better results compared to traditional denoising techniques like Gaussian filters or median filters.

Commercialization and/or Societal Impact Opportunites

- **Applications:** Healthcare, space research, and digital media industries
- **Key Values:** High-quality noise reduction applicable in fields requiring high precision image clarity, such as radiology and satellite data analysis
- **Potential Customers:** Hospitals, research organizations, photographers, and image processing software companies

Team Names & Collaborators

ARCS Students:

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Faculty:

Dr. Xiyi Hang, Electrical and Computer Engineering

Citations

Liang, J., Cao, J., Sun, G., Zhang, K., Van Gool, L., & Timofte, R. (2021). Swinir: Image restoration using swin transformer. *2021 IEEE/CVF International Conference on Computer Vision Workshops (ICCVW)*. https://doi.org/10.1109/iccvw54120.2021.00210

Chang, Z., & Cai, Q. (2023). Enhanced vision transformer with dual-dimensional self-attention for image recognition. *2023 IEEE 6th International Conference on Pattern Recognition and Artificial Intelligence (PRAI), 34*, 346–351. https://doi.org/10.1109/prai59366.2023.10332027

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