Denoising and Object Tracking in Adverse Conditions

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A comparative evaluation of denoising methods on improving tracking objects in rainy and hazy videos

Saniya Harrigan

Howard University, saniya.harrigan@bison.howard.edu,

Saurav Aryal

Howard University, saurav.aryal@howard.edu,

Gloria Washington

Howard University, gloria.washington@howard.edu

The goal of the VISTAC challenge is to improve visual object tracking under adverse weather conditions. While advanced tracking technologies perform well in controlled and well-lit environments, their performance decreases significantly in challenging conditions such as haze and rain. This limitation is critical because real-world applications, like traffic monitoring systems and autonomous vehicles, must operate reliably in unpredictable environmental settings. The challenge aims to develop robust tracking algorithms capable of maintaining accuracy and consistency in harsh environments.

This research investigates the effectiveness of different image denoising and filtering techniques for improving object tracking performances in degraded visual conditions. Using annotated video data containing hazy and rainy scenes, multiple preprocessing methods are applied to enhance frame clarity before tracking. The impact of each denoising technique is evaluated based on visual quality, feature preservation, and tracking performance metrics such as Qualitative Precision (QP) and effective frames per second.

CCS CONCEPTS • Computing methodologies • Artificial Intelligence • Computer Vision Problems

Additional Keywords and Phrases: Visual Tracking, adverse weather conditions, object tracking, ExtremeTrack dataset

REFERENCES

[1] Jiacheng Liu. 2024. RainyTrack: Enhancing Object Tracking in Adverse Weather Conditions with Siamese Networks. In *2024 the 7th International Conference on Image and Graphics Processing (ICIGP 2024), January 19--21,2024, Beijing,China.* ACM, New York, NY, USA 8 pages. https://doi.org/10.1145/3547649.3647698

[2] **Matthias Mueller, Neil Smith, and Bernard Ghanem. 2016.** A Benchmark and Simulator for UAV Tracking. In *European Conference on Computer Vision (ECCV 2016)*, October 11–14, 2016, Amsterdam, The Netherlands. Springer, 445–461. https://doi.org/10.1007/978-3-319-46448-0_27

[3] Martin A. Fischler and Robert C. Bolles. 1981. Random sample consensus: a paradigm for model fitting with applications to image analysis and automated cartography. Commun. ACM 24, 6 (June 1981), 381–395. https://doi.org/10.1145/358669.358692

[4] **Kaiming He, Jian Sun, and Xiaoou Tang. 2011.** Single Image Haze Removal Using Dark Channel Prior. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2011)*, June 20–25, 2011, Colorado Springs, CO, USA. IEEE, 1956–1963. https://doi.org/10.1109/CVPR.2011.5995308