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DesnowOracle: Quantifying Mask-Oracle Gap Recovery by a Training-Free Snow Prior in Compact Image Desnowing

[IIUM Engineering Journal](#) • Article • Open Access • 2026 • DOI: 10.31436/iiumej.v27i3.4662 [Gunawan, Teddy Surya](#)^a ; [Kartiwi, Mira](#)^b^a Department of Electrical and Computer Engineering, Kuliyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia[Show all information](#)

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Abstract

Snow occludes visual information needed by outdoor perception systems. This study evaluates whether a deterministic, training-free spatial snow-response map improves compact image desnowing beyond the effect of its conditioning branch. All conditions use a fixed approximately 2-million-parameter backbone and matched controls. Under the original 2,500-image, 100-epoch protocol, estimated-map SSM improves mean PSNR by 1.004 dB over Base and by 0.490 and 0.517 dB over zero- and shuffled-input SSM. A paired analysis averaging predictions across three seeds gives median gains of 0.387 and 0.420 dB, respectively. Under an extended protocol that also changes training-set size and learning-rate scheduling, this ordering reverses: estimated-map SSM trails zero and shuffled controls by 0.109 and 0.160 dB in mean PSNR. Thus, the experiments demonstrate protocol sensitivity, not an isolated convergence effect. A mask oracle remains an architecture-specific, synthesis-privileged diagnostic reference; the estimated map recovers 12.4 of its short-

protocol PSNR headroom. Results on 1,329 unpaired real images are mixed and indirect: no-reference indices favor the estimated map, whereas unlabelled detector counts do not distinguish its content from the controls. These findings show why spatial-prior claims require matched controls, correct repeated-measures analysis, and protocol checks. Copyright (c) 2026 IIUM Press. This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License. <https://creativecommons.org/licenses/by-nc/4.0/>

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