Variational Simultaneous Stereo Matching and Defogging in Low Visibility
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Introduction

• PROBLEM: We seek to estimate a dense disparity map and a defogged image from a rectified stereo pair of foggy images.
• RESEARCH GAP: Existing stereo matching algorithms are predominantly developed under the assumption of clear scenes. Meanwhile, most of the literature on defogging addresses single images only. There is very little work that tackles the two problems simultaneously.
• MOTIVATION: These two tasks are closely linked by scene depth, which can be inferred from disparity and scattering, respectively.
• SOLUTION: We propose a novel algorithm which effectively exploits this underlying connection and improves both results. It is based on variational continuous optimisation and does not require large scale training data, the acquisition of which is not always possible outdoors.

Method

• Our two-stage system consists of a Foggy Stereo Matching module and a Defogging module.
• The Foggy Stereo Matching module has the following features which get seamlessly incorporated into our disparity optimisation process.
  • An anisotropic weighting scheme to allow for non-uniform penalty parameters at different pixel locations.
  • A customised regularisation term which effectively injects disparity cues from scattering by encouraging gradient alignment.
• Within the Defogging module we leverage a photo-inconsistency check and perform a transmission refinement to enable the recovered depth information to assist defogging.

Results

• We evaluate our method qualitatively and quantitatively on both synthetic data (VKITTI2 [1], shown in paper) and real data (PAD [2], shown in paper and here).
• Our algorithm outperforms comparative methods in all metrics on depth estimation, and produces visually more appealing defogged images, especially in extremely low visibilities.

Future Work

• Use motion information embedded in consecutive frames and incorporate more matching constraints to improve depth estimation results
• Adopt a more sophisticated fog model (e.g. blurring and fog inhomogeneity) to better recover intensity images

References

Acknowledgements
We thank João F. C. Mota for helpful discussions. This work is supported by EPSRC funding for the Centre for Doctoral Training in Robotics and Autonomous Systems EP/S023208/1.

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