Focus stacking by multi-viewpoint focus bracketing

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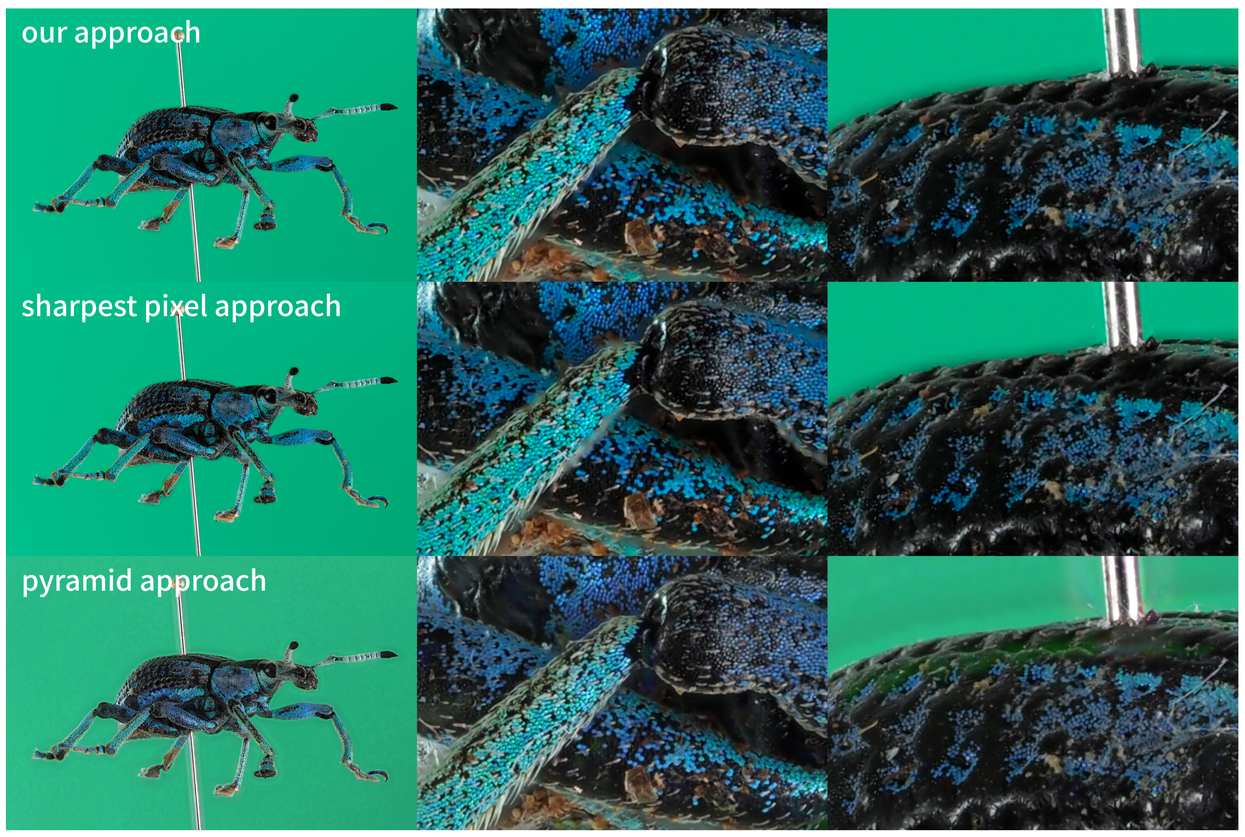
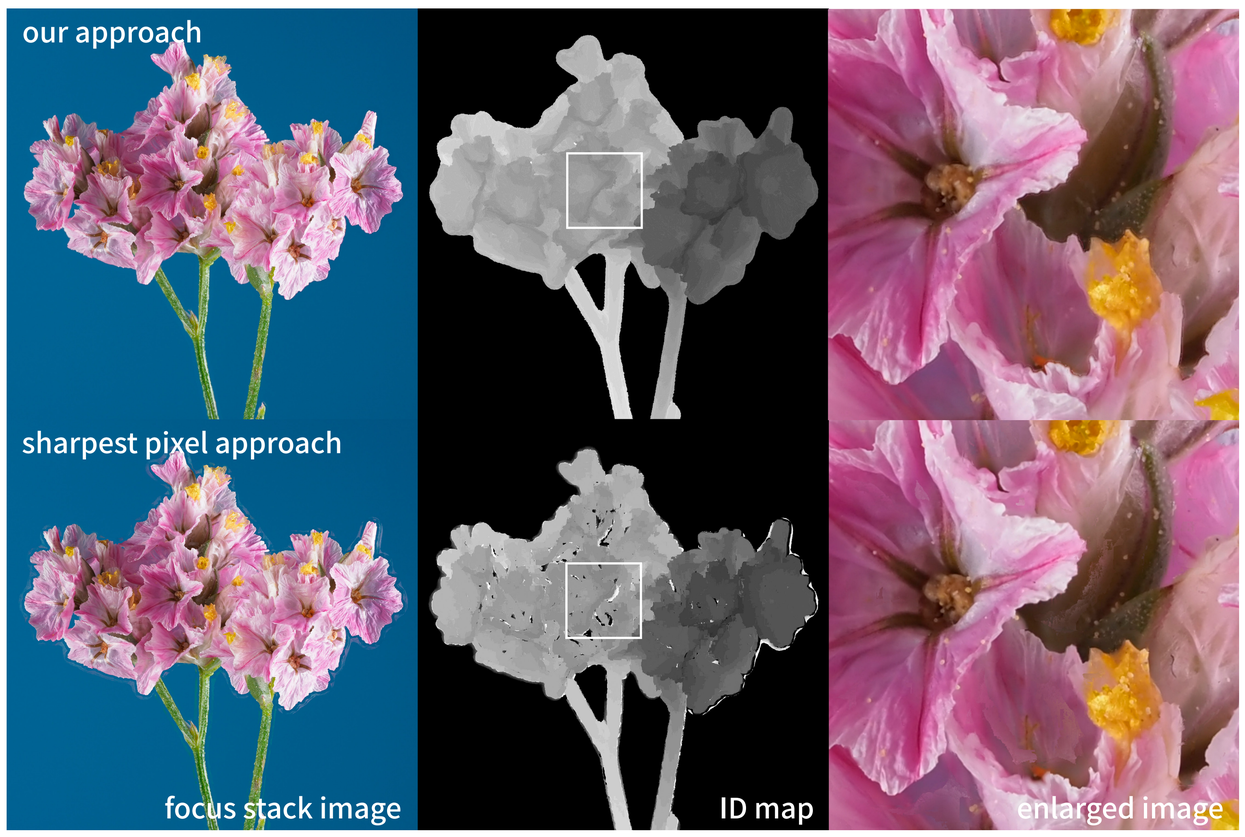




Abstract

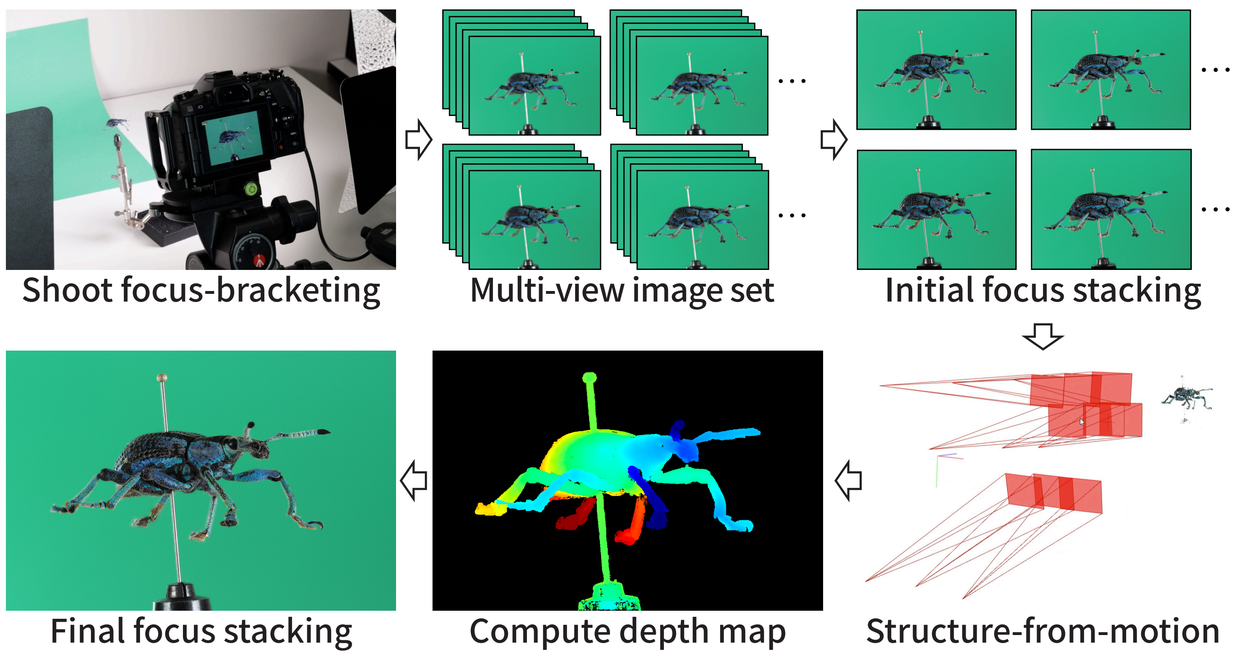
Background: Existing focus-stacking approaches (sharpest pixel or pyramid) cause artifacts around object boundaries.

Goal: High-quality focus-stacking images of small objects.

Approach: Focus-stacking by using the depth maps generated by multi-view stereo.

We present an approach to obtain high-quality focus-stacking images. The key idea is to integrate the multi-view structure-from-motion (SfM) [2] algorithm with the focus-stacking process. we carry out focus-bracketing shooting at multiple viewpoints, generate depth maps for all viewpoints by using the SfM algorithm, and compute focus stacking using the depth maps and local sharpness. By using the depth-maps, we successfully achieve focus-stacking results with less artifacts around object boundaries and without halo-artifacts, which was difficult to avoid by using the previous sharpest pixel and pyramid [3] approaches.

Overview of our approach



In the Final focus stacking, we linearly map the depth value into the index of photographs.

Acknowledgements

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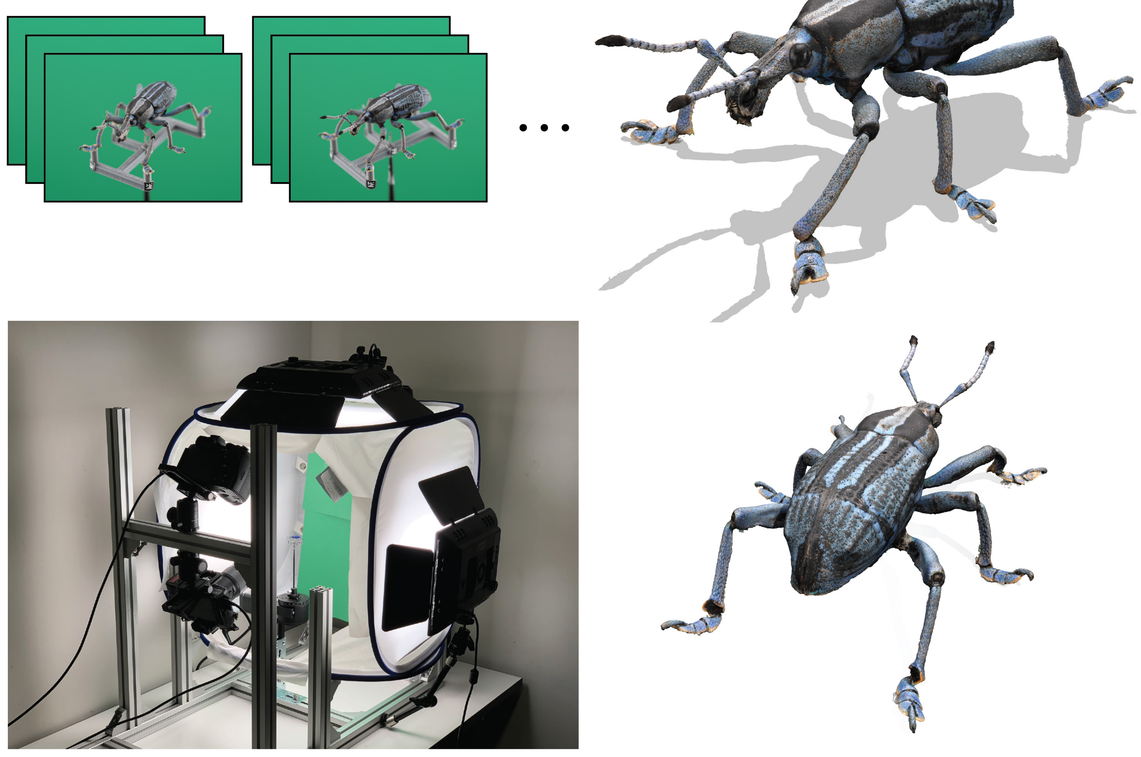
Results

By constructing depth maps from multi-view photographs and selecting pixels in focus by using the depth maps, our approach generated high-quality focus-staking images with smoother ID maps (see above).
Our approach is also useful for 3D digitization [1]. We placed a sample on a rotation stage and took 35 photographs each viewpoint, from 36 azimuth and 2 elevation angles. It was possible to reconstruct 3D insect models with highly detailed textures.



Limitations & Future work

- The quality depends on the quality of the depth maps.
- It is difficult to adopt our approach to an object without enough surface textures.
- We plan to develop a 3D digitization technique based on this approach.
- We plan to improve this approach and conduct a detailed evaluation.

References

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3. Wencheng Wang and Faliang Chang. 2011. A Multi-focus Image Fusion Method Based on Laplacian Pyramid. JCP 6, 12 (2011), 2559–2566.