

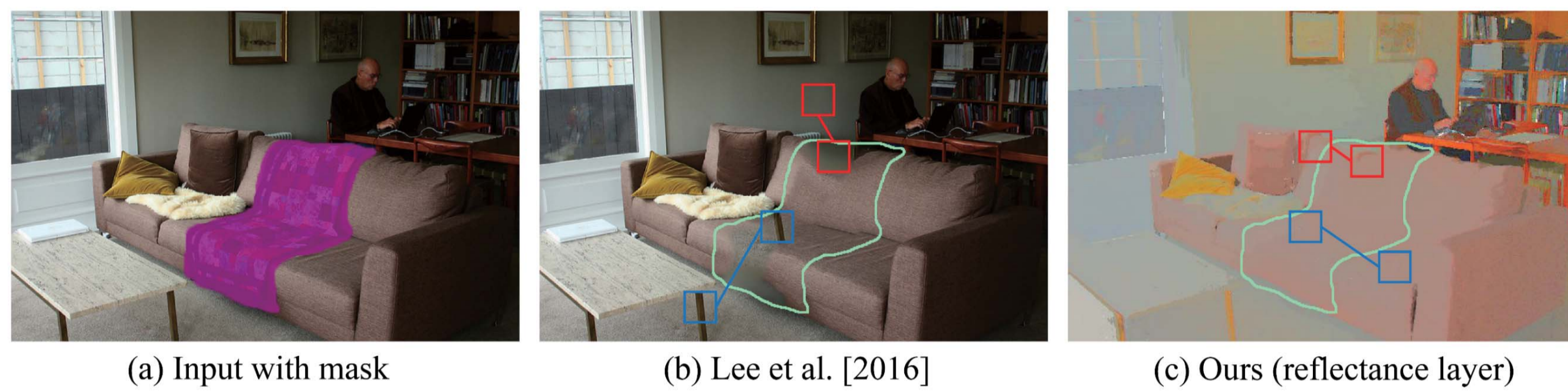
Image Completion with Intrinsic Reflectance Guidance

Soomin Kim Taeyoung Kim Min H. Kim Sung-Eui Yoon

KAIST

Motivation & Goal

- Scene illumination often causes **color changes** in the same materials in the image
- Many patch-based image completion methods are **based on color information**, so it often fails to find appropriate source patches due to illumination
- **Goal:** Utilize intrinsic **reflectance** to guide source patches along with color information.



Our Approach

1. Extract intrinsic reflectance
 - Intrinsic decomposition decomposes an image to reflectance (albedo) and shading (illumination)
 - Utilize only reflectance as illumination-invariant features
2. Build an image pyramid and fill the hole from the coarse to fine levels
3. Find candidate patches using a reflectance guided similarity function

$$E(p) = \sum_{Q_{I_k}, Q_{R_k} \in S_k} \min\{E_{coherence}(P_{I_k}, Q_{I_k}) + E_{guidance}(P_{R_k}, Q_{R_k})\}.$$

- The similarity function contains both image term and reflectance term P: patch Q: candidate patch I_k, R_k : k^{th} level of image and reflectance

$$E_{coherence}(P_{I_k}, Q_{I_k}) = \alpha_k C(P_{I_k}, Q_{I_k}) + \gamma C(\nabla^2 P_{I_k}, \nabla^2 Q_{I_k})$$

$$E_{guidance}(P_{R_k}, Q_{R_k}) = \beta_k C(P_{R_k}, Q_{R_k})$$

- Adaptive reflectance weight for each level

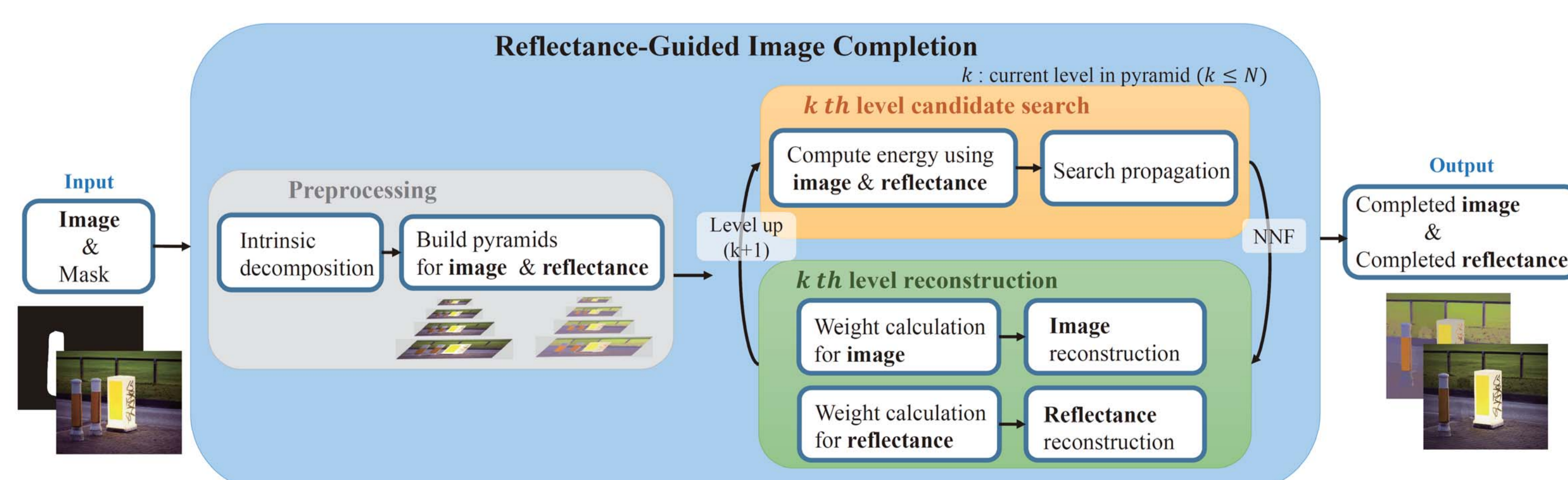
$$\beta_k = \beta - \Delta \text{ and } \alpha_k = \alpha + \Delta,$$

$$\Delta = \beta \times \frac{k-1}{N-1} \times \frac{\sigma_R}{\sigma_I},$$

Coarse level: more weight on reflectance
Fine level: more weight on image color

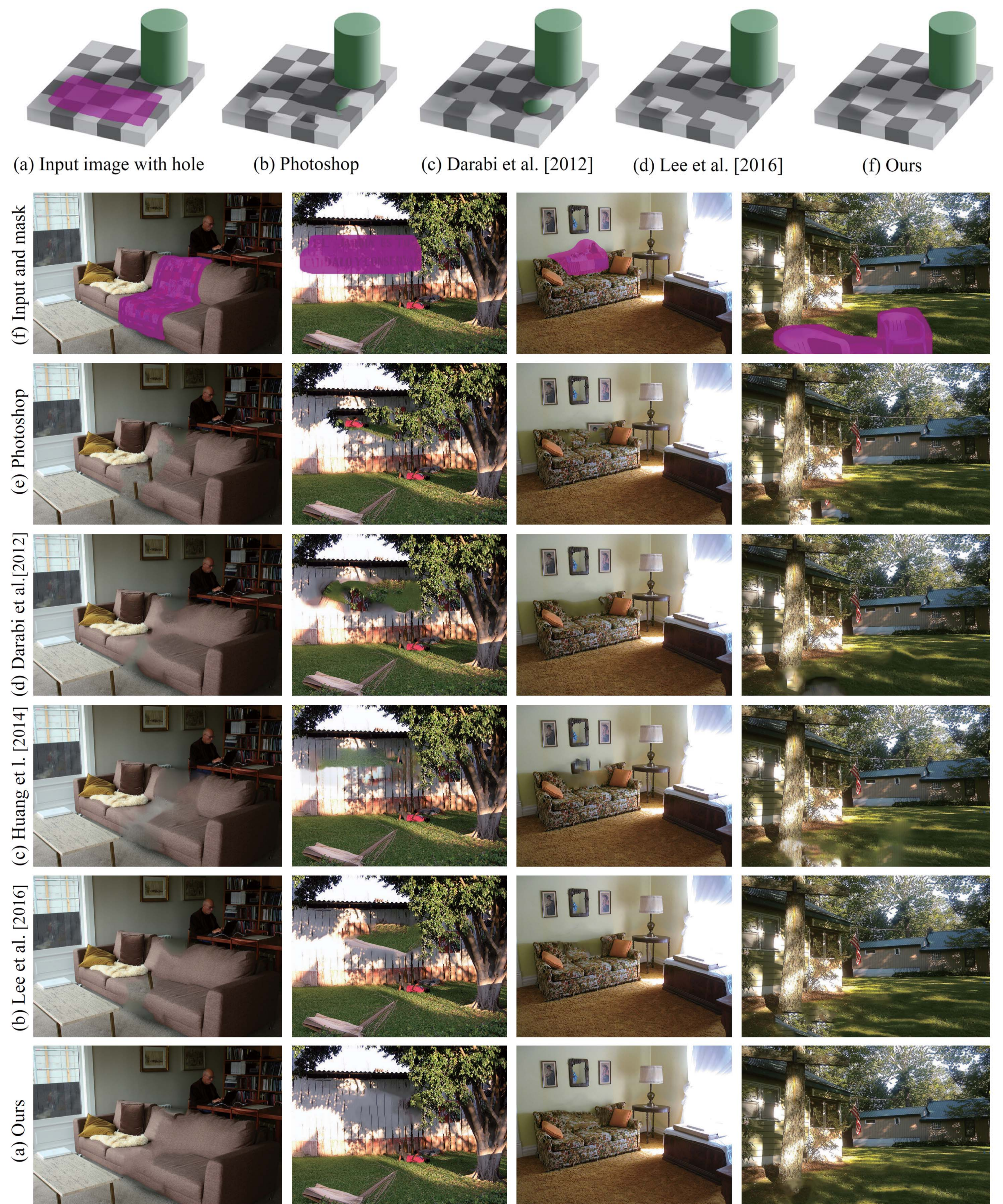
4. Reconstruct the image and reflectance with found source patches
 - Weighted sum of source patches according to similarity

$$D_{I|R}(p, q) = (1 - \gamma)C(P_{I|R}, Q_{I|R}) + \gamma C(\nabla^2 P_{I|R}, \nabla^2 Q_{I|R})$$

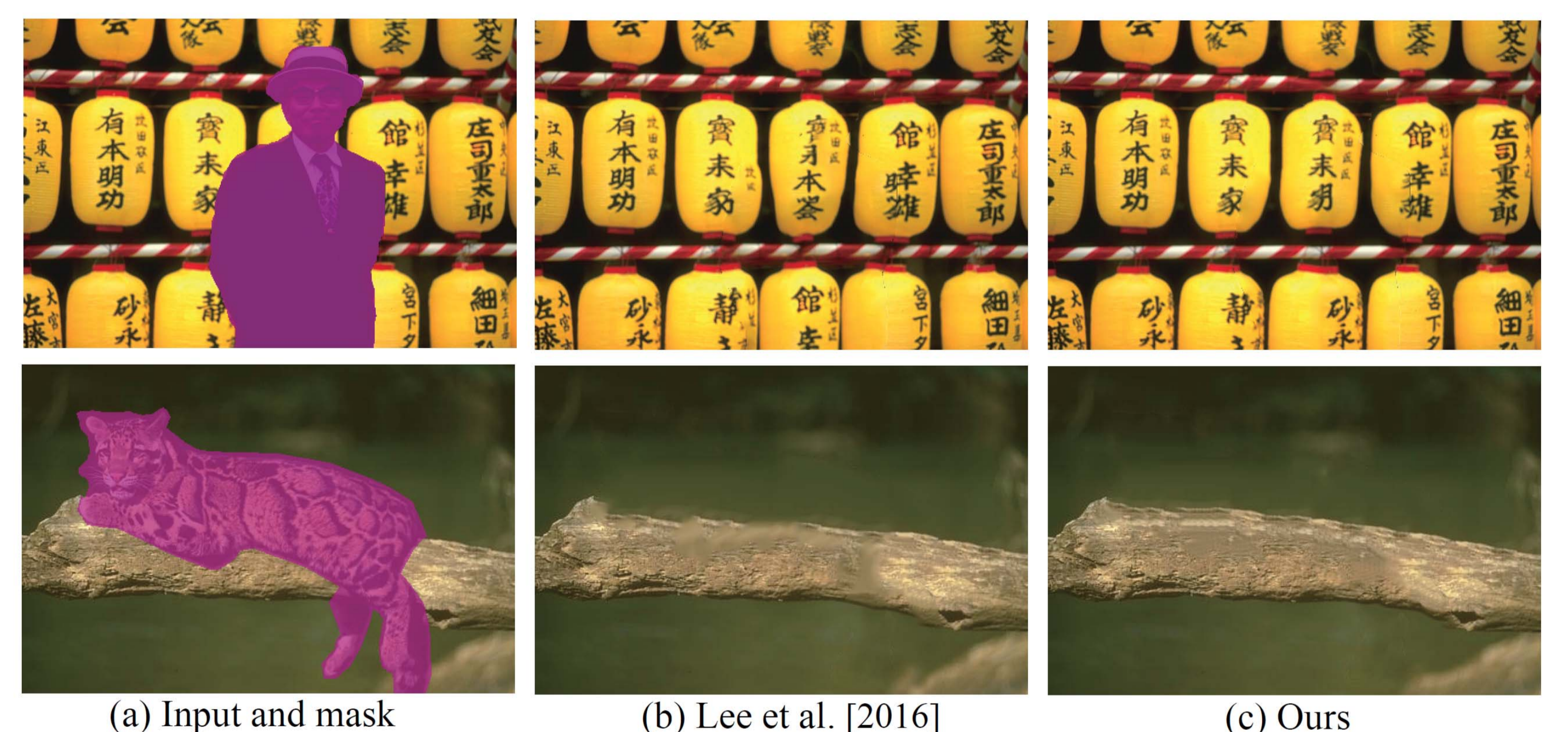


Result

- Scenes with significant illumination variation



- Commonly tested scenes



Conclusion

We have presented a reflectance-guided image completion method, which can handle a wide variety of images that include significant illumination variation.

References

- Soheil Darabi, Eli Shechtman, Connelly Barnes, Dan B Goldman, and Pradeep Sen. Image melding: Combining inconsistent images using patch-based synthesis. *ACM Trans. Graph.*, 31(4):82–1, 2012.
- Jia-Bin Huang, Sing Bing Kang, Narendra Ahuja, and Johannes Kopf. Image completion using planar structure guidance. *ACM Transactions on Graphics (TOG)*, 33(4): 129, 2014.
- Joo Ho Lee, Inchang Choi, and Min H. Kim. Laplacian patch-based image synthesis. In *Proc. IEEE (CVPR 2016)*

