

# Material Edition in Images

Master degree subject - M2R - MOSIG - GVR

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**Location/duration:** **Maverick team**, Inria (655 Avenue de l'Europe, 38334 Montbonnot), 5-6 months

**Keywords:** Computer Graphics, Image analysis & filtering, Material edition

**Context.** Image filters that can be found in graphics editors such as Gimp or Photoshop are limited to the manipulation of simple image features such as colors, edges, or textures. Editing higher level physical properties, such as shape, material and lights, can only be currently done by expert designers and requires a lot of time and skills. Consider the photos below: how could we modify the image of the Buddha in such a way that its stone material looks more shiny? Or how could we edit the hand object to smooth or remove highlights, change its material color, or even produce plausible Fresnel effects? In this project, we aim at designing new image filtering operators to tackle these problems and coherently edit perceived materials in images. Related works rely on drastic assumptions (such as “dark is deep”) in order to recover the physical components before re-synthesizing a novel image [KRFB06] or use a limited bank of filters in a multi-scale fashion to modify low-level material properties such as highlight intensities and roughness [BBPA15]. More recently, Fišer *et al.* [FJS<sup>+</sup>17] have also used patch-based texture synthesis approaches to transfer stylized appearances between images/videos of faces.



**Goal.** The goal of this project will be to provide new graphics editing tools (such as brushes) in order to edit the material appearance of an object in a given image. Ideally, these tools could be used to modify the diffuse color, the roughness (blurring/sharpening) and edges effects (Fresnel/asperity). It could also provide brushes to smooth/add/remove highlights, haze or spatial material variations.

**Approach.** A bibliography stage on image-based material edition and shape/material perception will first be conducted. The student will also have to test previous methods and check their limitations. The core of the project can be decomposed in two parts. The student will first have to analyse the structure of the input image. The goal of this step will be to extract the relevant information that will guide the filters: shape, flows, occlusions, etc. The flow-based features used in [VBBF16] could, for instance, be analysed at multiple scales to obtain a first description. An alternative could also be to start with either user-drawn or 3D-based data to start with correct and precise features. Once we have a good image decomposition, the student will design new filters to edit material properties. For instance, modifying the diffuse color should not affect other layers such as shininess. The filters will have to smooth the image without altering the shape properties (silhouettes/curvature/etc). The student will be able to take inspiration from [ZMB<sup>+</sup>15, ZGVB16] to design the first pipelines. He will also create different types of visualizations to analyse how material properties (BRDFs) impact images.

## References

- [BBPA15] Iwaylo Boyadzhiev, Kavita Bala, Sylvain Paris, and Edward Adelson. Band-sifting decomposition for image-based material editing. *ACM Trans. Graph.*, 34(5):163:1–163:16, November 2015.
- [FJS<sup>+</sup>17] Jakub Fišer, Ondřej Jamriška, David Simons, Eli Shechtman, Jingwan Lu, Paul Asente, Michal Lukáč, and Daniel Šýkora. Example-based synthesis of stylized facial animations. *ACM Transactions on Graphics*, 36(4), 2017.
- [KRFB06] Erum Arif Khan, Erik Reinhard, Roland W. Fleming, and Heinrich H. Bühlhoff. Image-based material editing. *ACM Trans. Graph.*, 25(3):654–663, July 2006.
- [VBBF16] Romain Vergne, Pascal Barla, Georges-Pierre Bonneau, and Roland Fleming. Flow-Guided Warping for Image-Based Shape Manipulation. *ACM Transactions on Graphics (TOG)*, July 2016.
- [ZGVB16] Carlos J. Zubiaga, Gael Guennebaud, Romain Vergne, and Pascal Barla. Local Shape Editing at the Compositing Stage. In *27th Eurographics Symposium on Rendering (ESRG)*, EGSR '16 Proceedings of the Eurographics Symposium on Rendering: Experimental Ideas & Implementations, pages 23–32, Dublin, Ireland, June 2016. The Eurographics Association.
- [ZMB<sup>+</sup>15] Carlos J. Zubiaga, Adolfo Muñoz, Laurent Belcour, Carles Bosch, and Pascal Barla. MatCap Decomposition for Dynamic Appearance Manipulation. In *Eurographics Symposium on Rendering 2015*, Darmstadt, Germany, June 2015.