L'ORÉAL
Research & Innovation

Topic: Hair Rendering for the Digitalization of Hair Coloration and Applications in AR/VR.

Supervisor: BOKARIS Panagiotis-Alexandros (contact: pbokaris@rd.loreal.com)

Group: Applied Optics and Algorithms

Desired Period: February/March 2018 – August/September 2018 (flexible)

Location: 9 rue Pierre Dreyfus, 92110, Clichy, France (Paris area)

Short description

The modelling and rendering of human hair is an extremely challenging topic in the fields of computer graphics and vision. There is a significant trade-off between approaches that opt for physico-realistic rendering and others that try to reduce the calculation time towards real time approximations. This master thesis will focus on hair rendering for hair color appearance matching and its potential application in AR/VR projects.
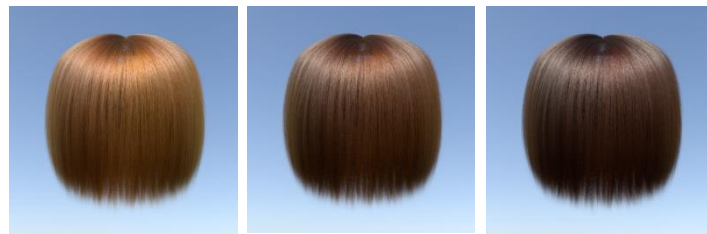
(results by pbrt API)

(Zhang et al., SIGGRAPH 2017)

Objectives

The main objectives of this master thesis are:

- Analyze state-of-the-art methods in the literature in hair-light interaction and modelling while focusing on hair color appearance.
- Test current software (commercial and/or open source), for modelling and rendering human hair (such as 3dsMAX, Maya, Renderman, Nvidia HairWorks, etc.)
- Develop novel methods of natural hair rendering and simulate hair coloration in collaboration with L'Oréal labs of hair coloration and hair "make-up".

- Apply the outcome of this research in innovative projects for beauty personalization and digitalization of hair color prediction.
- Explore the potential of deploying the hair rendering methods in AR/VR applications where real-time calculations are crucial.

During this period the selected candidate will learn to:
- Address a topic which is very challenging both scientifically and technically.
- Enhance her/his background in computer graphics, AR/VR, applied color science.
- Work in a team on a multidisciplinary topic.
- Discover the universe of personalized beauty and innovation.

Apart from the supervisor the selected candidate is encouraged to collaborate with: L'Oréal labs of hair coloration and hair "make-up", other members of the group Applied Optics and Algorithms (optical engineers, data scientists), the group Artificial Intelligence and potentially academic and/or industrial partners on the topics of hair-light interaction and physico-realistic hair rendering.

Candidate's profile
Main scientific and technical desired skills and knowledge: computer graphics, image processing, color science, computer vision, physics simulation, computer science.

Solid background in optics, computer science, computer graphics, physics, simulation of matter-light interaction (examples of current studies: Télécom, Master COSI, Supoptique, ENSIMAG, etc.).

Working language: English and/or French (not mandatory).

Software skills: C++, OpenGL, 3dsMax, Blender, rendering APIs (such as Nvidia HairWorks, PBRT, Renderman, etc.)

This master thesis lies at the core of beauty personalization and digitalization on the challenging subject: "Rendering and Color Appearance of Hair for Projects in Personalized Beauty"

Relevant literature
[1] Zhang et al., "A data-driven approach to four-view image-based hair modeling", SIGGRAPH 2017.
[2] Chai et al., "AutoHair: fully automatic hair modelling from a single image", SIGGRAPH 2016.
[3] Marschner et al., "Light scattering from human hair fibers", SIGGRAPH 2003.
[4] D'Eon et al., "An energy-conserving hair reflectance model", Eurographics 2011.
[5] Matt Pharr, "The implementation of hair scattering model", PBRT, http://www.pbrt.org/hair.pdf, 2016
[6] NVIDIA, "nVIDIA HairWorks", http://docs.nvidia.com/gameworks/content/artisttools/hairworks/index.html, 2014