Post-doctoral research visits at Inria

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Accurate Light Transport Simulation for virtual design of material appearance

Position type: Post-doctoral Fellow

Functional area: Bordeaux (Talence)

Research theme: Applied Mathematics, computation and simulation

Project: MANAO

Scientific advisor: pascal.barla@inria.fr

HR Contact: laure.pottier_schupp@inria.fr

Application deadline: 21/04/2017

About Inria and the job

Inria, the French National Institute for computer science and applied mathematics, promotes “scientific excellence for technology transfer and society”. Graduates from the world’s top universities, Inria's 2,700 employees rise to the

challenges of digital sciences. With its open, agile model, Inria is able to explore original approaches with its partners in industry and academia and provide an efficient response to the multidisciplinary and application challenges of the digital transformation. Inria is the source of many innovations that add value and create jobs.

Mission

Since the beginning of the industrial era, prototyping has been an important stage for manufacturers as a preliminary step before mass production. With the rise of Computer Science and the recent advances of intensive computation, the industry is progressively shifting from a tangible prototype to a fully numerical and virtual prototype with the goal of reducing costs during the R&D phase. Beyond the shape of an object, predicting the final appearance of a virtual prototype remains a challenge of high potential for many domains (e.g., furniture, textiles, architecture). The challenge is mainly due to the fact that the final appearance of an object is dependent on its shape, the material(s) applied on it as well as the viewing and lighting conditions.

Solving the inverse problem (c.f. online figure) that goes from Pictorial Design [A], where a designer specifies a targeted appearance directly in a synthetic image, to the Operational Design [D] where a specialist controls the fabrication process, is very hard and ill posed.

Even when restricting the inverse problem inside the virtual world, inferring directly the different multi-layered materials from a targeted appearance for a whole a 3D scene ([A] to [C]) reveals itself to be a very challenging task. Therefore, our main research goal is, first to develop an inverse model that can infer a multi-layered materials from a radiometric design (BSDF) for a small planar surface ([B] to [C]) and second, to validate their final appearance in a 3D scene ([B] to [A]).

Job offer description

The primary goals of this post-doc offer are:

1. To develop a fast Radiance Transfer Equation (RTE) simulator (e.g., [1]) for given a multi-layered material that will predict the scattering of light from a small surface.
2. To develop an invertible BSDF model to enable inverse design according to the knowledge acquired previously.
3. To validate the obtained radiometric design for a whole 3D scene by developing and/or integrating the BSDF model in a spectral and polarized light transport simulator.

As future work, filling the gap between the virtual and the real world ([C] to [D]) could be done through collaboration with industrial partners.

The RTE simulator (goal 1) is required to understand the influence of combined layers in terms of radiometric response (BSDF) but also in order to be able to validate the final inverse BSDF (goal2). More precisely, we are aiming at layered materials than can be found by assembling natural/mineral materials but also artificial ones (e.g., meta-materials), which have received a lot of attention from the industry world. Each layer may be homogeneous (constant index of refraction for the whole layer) or heterogeneous (i.e., they can contain particles or flakes etc.). In both cases, particles or indexes of refraction can exhibit strong wavelength or polarization dependencies. Therefore, the candidate will also have to study their importance for the final BSDF model, and inspect their visual impact at the pictorial scale (goal 3).

Skills and profile

Degree:

PhD in Computer Science, specialized in rendering (preferred)

or PhD in Physics, specialized in light transport.

Technical skills:

- Mastery of C++, OpenGL and CUDA languages.

- Good knowledge of numerical tools such as Octave or Matlab will be appreciated

Benefits

Possibilities of on-site catering

Partial coverage of the transport costs in common

For more information about the job or to apply, please contact pascal.barla@inria.fr or Xavier.granier@inria.fr

For information of an administrative nature or in case of difficulty to transmit his candidature, contact laure.pottier_schupp@inria.fr Duration of contract: 16 months

Predictable date of hiring: in November 1st, 2017

Proposed salary: 2653 euros gross/ monthly 2132,97 euros clear / monthly

As part of its diversity policy, the Institute's posts are open to people with disabilities.

Additional information

References

[1] *Parallel computing with graphics processing units for high-speed Monte Carlo simulation of photon migration*. Journal of Biomedical Optics, 13(6):060504– 060504–3, 2008.

[2] *Directional dipole model for subsurface scattering*. ACM Trans. Graph., 34(1). December 2014.

[3] *A comprehensive framework for rendering layered materials*. ACM Trans. Graph., 33(4) July 2014.

[4] *Theory for off-specular reflection from roughened surfaces*. J. Opt. Soc. Am., 57(9), Sep 1967.

[5] *Microfacet models for refraction through rough surfaces*. EGSR'07, pages 195–206.

Security and defense procedure
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).
Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

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Application requirements

- You must have defended your thesis at the beginning of the contrat of employment
- The post doctoral research visits has to be realise in a really different scientific environment than the one of the Phd : Particular attention will be paid to French and international candidates who have studied their PhD abroad, but all high-quality applications will be carefully considered.
- Nationality is not taken into consideration.

- Documents required for the application: the candidate's CV, a list of the candidate's publications as well as the two most significant publications provided in full, a cover letter, one or more letters of recommendation (Recommandants will send directly their letter to the scientific advisor indicated on the offer, and a copy in the HR contact), and a statement of career plans subsequent to the post-doctoral position.

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