SIMON LUCAS

Postdoctoral Researcher in Computer Graphics

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RESEARCH INTERESTS

I am a postdoctoral researcher at Inria Sophia Antipolis in the GraphDeco team. My research focuses on physically based and real-time rendering. I develop practical models and sampling methods for complex materials, while also exploring Gaussian-based representations for editable radiance fields and efficient global illumination.

EDUCATION

Ph.D. — October 2021 – December 2024

University of Bordeaux, Inria Bordeaux — France, Bordeaux

Thesis title: *A micrograin formalism for the rendering of porous materials.*
Supervisors: Pascal Barla, Romain Pacanowski

M.Sc. Computer Science, "Image and 3D" — September 2019 – August 2021

University of Strasbourg — France, Strasbourg

Thesis title: *Procedural Texture Synthesis using Tiling and Blending*.
Supervisors: Basile Sauvage, Xavier Chermain
+ Master of Engineering – Computer Science, Image, Virtual Reality, Interaction and Games

B.Sc. Computer Science — September 2016 – June 2019

University of Strasbourg — France, Strasbourg

+ Master of Engineering – Computer Science, Image, Virtual Reality, Interaction and Games

Scientific Baccalauréat — 2016

Lycée Marc Chagall — France, Reims

WORK EXPERIENCE

Postdoctoral Researcher — 2025 - present

Inria Sophia-Antipolis, GraphDeco team

- Physically based rendering
- Light transport
- Real-time rendering
- Novel View Synthesis
- Relighting

PhD Student — 2021 - 2024

Inria Bordeaux, Manao team, University of Bordeaux

- Appearance modeling for porous materials
- Physically based rendering

Apprenticeship — September 2020 - August 2021

ICube laboratory, University of Strasbourg

- Real-time rendering of glints
- Procedural texture generation

Third-year Internship — July 2019 - August 2019

United Visual Researchers, Paris

- BRDF fitting
- Shader programming in Unity

First-year Internship — June 2017 - July 2017

OPEX MEDIA / USE TOGETHER, Reims

- RPM package automation on CentOS 7
- Beta testing

PUBLICATIONS

Journal Articles

[Lan+26] Alexandre Lanvin, Jeffrey Hu, **Simon Lucas**, Adrien Bousseau, and George Drettakis. "Intrinsic decomposition and editing of 3D Gaussian splats". In: *Proc. ACM Comput. Graph. Interact. Tech.* 9.1 (May 2026). DOI: `10.1145/3804495`. URL: `https://doi.org/10.1145/3804495`

Abstract. Intrinsic decomposition - which expresses image colors as the product of diffuse albedo and shading, possibly augmented with view-dependent residuals - has a long history in image editing as it enables the modification of object colors and textures without altering lighting. We extend intrinsic decomposition to radiance fields represented with Gaussian splatting by proposing solutions to three key aspects of such decomposition. First, we describe how to model the intrinsic decomposition as independent sets of Gaussian primitives, which allows each set to adapt to the characteristics of the layer it represents. Second, we present an optimization procedure guided by data-driven predictions to disentangle multi-view photographs of a scene into the aforementioned intrinsic sets. Finally, we provide an editing workflow where users modify the texture of planar surfaces simply by modifying the albedo of that surface in one image. Capturing this edit within the intrinsic radiance field allows re-rendering of the edited scene with plausible lighting under arbitrary viewpoints.

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[SLD26] Ishaan Shah, **Simon Lucas**, and George Drettakis. "Frequency-Aware Spatio-Angular Gaussians for Efficient Global Illumination Precomputation and Real-Time Rendering". In: *Computer Graphics Forum* 44.7 (2026). DOI: `10.1111/cgf.70542`

Abstract. Precomputation and efficient approximate material models are well-known approaches for achieving real-time rendering with global illumination. Recent research in radiance fields and in particular 3D Gaussian Splatting has demonstrated the power of Gaussian primitives both to represent radiance and for fast optimization. Inspired by these advances, we propose a new representation to precompute global illumination, by using 3D Gaussians for the spatial and spherical Gaussians for the directional component of lighting. Critically, we precompute and store incoming radiance, thus requiring the optimization of a spatially smooth function, and we exploit the properties of anisotropic spherical Gaussians for very fast evaluation during rendering. We introduce a frequency-aware sampling method, that guides both the placement of precomputed ground truth illumination samples and the placement of the Gaussians, both spatial and angular. Our approach provides very fast optimization, for a total precomputation time of less than 6 minutes for our test scenes, and better quality rendering than competing approaches at the same frame rates.

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[Xu+26] Kewei Xu, **Simon Lucas**, Mickaël Ribardière, Benjamin Bringier, and Pascal Barla. "A Discrete Polydisperse Anisotropic BSDF Model based on the Micrograin Framework". In: *Computer Graphics Forum* n/a.n/a (2026), e70387. DOI: `https://doi.org/10.1111/cgf.70387`. eprint: `https://onlinelibrary.wiley.com/doi/pdf/10.1111/cgf.70387`. URL: `https://onlinelibrary.wiley.com/doi/abs/10.1111/cgf.70387`

Abstract. We introduce a discrete polydisperse micrograin BSDF model for the rendering of porous surface materials composed of microscopic elements of different size, shape and reflectance distributed on a bulk medium. Our approach generalizes the anisotropic monodisperse micrograin model. We first reformulate it in a non-axis-aligned configuration, allowing for the later combination of different micrograin types elongated in arbitrary directions. We then extend the monodisperse model to the polydisperse case, deriving its three key components: (i) a general filling factor that controls the mix between micrograins and the bulk medium; (ii) an exact normal distribution function for surfaces composed of polydisperse micrograin distributions; and (iii) the corresponding fully-correlated shadowing and masking term. This results in an analytical single-scattering BSDF for discrete polydisperse surface materials, validated over ground truth simulations, for which we also derive a dedicated importance sampling procedure. Our model supports varying heights and anisotropy orientations of different micrograin types as input, giving additional control to simulate phenomena like retroreflection from mixed materials, color mixture depending on lighting and observation directions, and multiple directions of anisotropy.

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[LPB25] **Simon Lucas**, Romain Pacanowski, and Pascal Barla. "Importance Sampling of the Micrograin Visible NDF". in: *Computer Graphics Forum* 44.4 (2025), e70174. DOI: `https://doi.org/10.1111/cgf.70174`. eprint: `https://onlinelibrary.wiley.com/doi/pdf/10.1111/cgf.70174`. URL: `https://onlinelibrary.wiley.com/doi/abs/10.1111/cgf.70174`

Abstract. Importance sampling of visible normal distribution functions (vNDF) is a required ingredient for the efficient rendering of microfacet-based materials. In this paper, we explain how to sample the vNDF for the micrograin material model [LRPB23], which has been recently improved to handle height-normal correlations through a new Geometric Attenuation Factor (GAF) [LRPB24], leading to a stronger impact on appearance compared to the earlier Smith approximation. To this end, we make two contributions: we derive analytic expressions for the marginal and conditional cumulative distribution functions (CDFs) of the vNDF; we provide efficient methods for inverting these CDFs based respectively on a 2D lookup table and on the triangle-cut method [Hei20].

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[Luc+24] **Simon Lucas**, Mickaël Ribardière, Romain Pacanowski, and Pascal Barla. "A Fully-Correlated Anisotropic Micrograin BSDF Model". In: *ACM Trans. Graph.* 43.4 (July 2024), 111:1–111:14. ISSN: 0730-0301. DOI: `10/gt48v6`. (Visited on 07/25/2024)

Abstract. We introduce an improved version of the micrograin BSDF model [Lucas et al. 2023] for the rendering of anisotropic porous layers. Our approach leverages the properties of micrograins to take into account the correlation between their height and normal, as well as the correlation between the light and view directions. This allows us to derive an exact analytical expression for the Geometrical Attenuation Factor (GAF), summarizing shadowing and masking inside the porous layer. This fully-correlated GAF is then used to define appropriate mixing weights to blend the BSDFs of the porous and base layers. Furthermore, by generalizing the micrograins shape to anisotropy, combined with their fully-correlated GAF, our improved BSDF model produces effects specific to porous layers such as retro-reflection visible on dust layers at grazing angles or height and color correlation that can be found on rusty materials. Finally, we demonstrate very close matches between our BSDF model and light transport simulations realized with explicit instances of micrograins, thus validating our model.

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[Che+21] Xavier Chermain, **Simon Lucas**, Basile Sauvage, Jean-Michel Dischler, and Carsten Dachsbacher. "Real-Time Geometric Glint Anti-Aliasing with Normal Map Filtering". In: *Proc. ACM Comput. Graph. Interact. Tech.* 4.1 (Apr. 2021). DOI: 10.1145/3451257. URL: https://doi.org/10.1145/3451257

Abstract. Real-time geometric specular anti-aliasing is required when using a low number of pixel samples and high-frequency specular lobes. Several methods have been proposed for mono-lobe bidirectional reflection distribution functions (BRDFs), but none for multi-lobe BRDFs, e.g., a glinty BRDF. We present the first method for real-time geometric glint anti-aliasing (GGAA). It eliminates most of the inconsistent appearing and disappearing of glints on surfaces with significant curvatures during animations. The technique uses the glinty BRDF of Chermain et al. [2020] and leverages hardware GPU-filtering of textures to filter slope distributions on the fly. We also improve this glinty BRDF by adding a correlation factor of slope. This BRDF parameter allows convergence to normal distribution functions that are not aligned on the surface's axes. Above all, this parameter makes glint rendering compatible with normal map filtering using LEAN mapping. Using GGAA increases the rendering time from 0.6% to 4.2% and it requires 1/3 more memory due to MIP mapping of tabulated slope distributions. The results are compared with references using a thousand samples per pixel.

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Conference Proceedings

[Luc26] **Simon Lucas**. "Correlated Smith Visibility from NDF-Derived Shapes". In: *Joint MAM MANER APPMAT Workshop on Material Appearance Modeling*. Bordeaux (France), France, 2026. URL: https://simon-lucas.fr/assets/papers/correlated_smith_mam2026.pdf

Abstract. Smith masking-shadowing is widely used in microfacet BRDFs to model the visibility in rough surfaces. Existing Smith models usually correlate visibility through height and or direction, but do not derive the directional correlation from the normal distribution function itself. In this work, we propose a first height-direction correlated Smith visibility term where the correlation is computed from an NDF-derived shape. For any isotropic NDF, we construct a representative shape whose normal distribution matches the target NDF. The NDF-dependent correlation term can then be recovered by measuring the overlap between the shadows cast by the NDF shape for the incoming and outgoing directions.

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[Luc+23] **Simon Lucas**, Mickael Ribardiere, Romain Pacanowski, and Pascal Barla. "A Micrograin BSDF Model for the Rendering of Porous Layers". In: *ACM SIGGRAPH Asia Conference Papers*. SA '23. New York, NY, USA: Association for Computing Machinery, Dec. 2023, pp. 1–10. ISBN: 979-8-4007-0315-7. DOI: 10/gtb6cz. (Visited on 01/03/2024)

Abstract. We introduce a new BSDF model for the rendering of porous layers, as found on surfaces covered by dust, rust, dirt, or sprayed paint. Our approach is based on a distribution of elliptical opaque micrograins, extending the Trowbridge-Reitz (GGX) distribution [Trowbridge and Reitz 1975; Walter et al. 2007] to handle pores (i.e., spaces between micrograins). We use distance field statistics to derive the corresponding Normal Distribution Function (NDF) and Geometric Attenuation Factor (GAF), as well as a view- and light-dependent filling factor to blend between the porous and base layers. All the derived terms show excellent agreement when compared against numerical simulations. Our approach has several advantages compared to previous work [d'Eon et al. 2023; Merillou et al. 2000; Wang et al. 2022]. First, it decouples structural and reflectance parameters, leading to an analytical single-scattering formula regardless of the choice of micrograin reflectance. Second, we show that the classical texture maps (albedo, roughness, etc.) used for spatially-varying material parameters are easily retargeted to work with our model. Finally, the BRDF parameters of our model behave linearly, granting direct multi-scale rendering using classical mip mapping.

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[LPB22] **Simon Lucas**, Romain Pacanowski, and Pascal Barla. "Analyse Numérique de Modèles de Matériaux Poreux". In: *JFIG 2022 - Journées Françaises de l'Informatique Graphique*. Bordeaux (France), France, Nov. 2022. URL: https://hal.science/hal-03952096

Abstract. L'apparence des objets est impactée par leur structure microscopique. Ici nous nous intéressons à l'apparence de matériaux poreux. La présence de pores a été modélisée de deux manières dans les travaux existants : en modifiant l'état de surface d'un matériau, ou en modifiant ses propriétés volumiques. Il n'existe cependant pas de modèle de matériaux poreux suffisamment générique pour tenir compte à la fois des effets surfaciques et volumiques. Nous proposons dans cet article une étude de ces effets à l'aide de simulations du transport de la lumière. Cette approche permet de révéler les limitations des modèles existants, ainsi que des pistes prometteuses pour le développement futur d'un modèle de matériau suffisamment général pour tenir compte de variations de porosités et d'état de surface.

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Thesis

[Luc24] **Simon Lucas**. “A micrograin formalism for the rendering of porous materials”. Theses. Université de Bordeaux, Dec. 2024. DOI: 10.70675/3f2098c0z2586z46a6za919z91b6f5489097. URL: https://theses.hal.science/tel-04904484

Abstract. This thesis focuses on the impact of microscopic structures on material appearance, with a particular emphasis on porous materials. We first evaluated existing appearance models by conducting light transport simulations on sphere aggregates representing porous volumes. We found that none of the existing models accurately matched the simulations, with most errors arising from surface effects. This opened the path to the development of a specialized Bidirectional Scattering Distribution Function (BSDF) model for rendering porous layers, such as those found on surfaces covered with dust, rust, or dirt. Our model extends the Trowbridge-Reitz (GGX) distribution to handle pores between elliptical opaque micrograins and introduces a view- and light-dependent filling factor to blend porous and base layers. By adding height-normal and light-view correlations in the masking and shadowing terms, our model produces realistic effects seen in real world materials that were previously hardly obtainable like retro-reflection and height-color correlations. To improve the rendering efficiency of micrograin materials, we introduce an efficient importance sampling routine for visible Normal Distribution Functions (vNDF). Through numerical simulations, we validate the accuracy of our model. Finally, our work provides a comprehensive formalism for rendering porous layers and opens many perspectives for future work.
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ACHIEVEMENTS

- JFIG 2022, 3rd Best Paper Award
- JFIG 2020, Best shader at Shadertoy rendering contest
- Nuit de l’Informatique 2018 awards

SKILLS

Python, C++, C | OpenGL, GLSL | OptiX / CUDA | Compute shaders | Ray tracing | Physically based rendering | Procedural rendering | Implicit surfaces | Deep learning

LANGUAGES

- French, native
- English

REVIEWING

- SIGGRAPH 2024, 2026
- SIGGRAPH ASIA 2025
- I3D 2024

COMMITTEES

- JFIG Best Shader, 2022 and 2023

INTERESTS

Climbing | Archery | Video games | Coding and 3D rendering