# Physically Based Shading in Theory and Practice

Stephen Hill, Stephen Mcauley, Jonathan Dupuy, Yoshiharu Gotanda, Eric
Heitz, Naty Hoffman, Sébastien Lagarde, Anders Langlands, Ian Megibben,
Farhez Rayani, et al.

# Physically Based Shading in Theory and Practice

Stephen Hill  
Ubisoft Montreal

Stephen McAuley  
Ubisoft Montreal

Jonathan Dupuy  
LIGUM,* LIRIS†

Yoshiharu Gotanda  
tri-Ace

Eric Heitz  
INRIA; CNRS; Univ. Grenoble Alpes

Naty Hoffman  
2K

Sébastien Lagarde  
EA Frostbite

Anders Langlands  
Solid Angle

Ian Megibben  
Pixar Animation Studios

Farhez Rayani  
Pixar Animation Studios

Charles de Rousiers  
EA Frostbite

© Disney/Pixar

## 1 Abstract

Physically based shading is transforming the way we approach production rendering, and simplifying the lives of artists in the process. By adhering to physically based, energy-conserving models, one can easily create realistic materials that maintain their properties under a variety of lighting conditions. In contrast, traditional ad hoc models have required extensive tweaking to achieve the same result. Building upon previous incarnations of the course, we present further research and practical advice on the subject, from film and game production.

LEVEL OF DIFFICULTY: Intermediate

INTENDED AUDIENCE: Practitioners from videogame, CG animation, and VFX fields, plus researchers interested in shading models.

PREREQUISITES: A basic understanding of computer graphics, lighting and shading models.

## 2 Schedule

PHYSICS AND MATH OF SHADING *(Hoffman)*  
A speed-of-light tour of the physics of light-matter interaction and how it is expressed in simple shading models.

UNDERSTANDING THE MASKING-SHADOWING FUNCTION *(Heitz)*  
Eric unmasks and intuitively explains this oft-misunderstood microfacet function, leading to fresh insights and results.

ANTIALIASING PHYSICALLY BASED SHADING WITH LEADR MAPPING *(Dupuy)*  
Jonathan describes the tools necessary to robustly filter microfacet BRDFs in the presence of normal or displacement mapping.

DESIGNING REFLECTANCE MODELS FOR NEW CONSOLES *(Gotanda)*  
This talk covers improved real-time shading models, afforded by the latest wave of videogame hardware.

*Break*

MOVING FROSTBITE TO PBR *(Lagarde and de Rousiers)*  
Séb and Charles explain how the Frostbite team (and multiple productions) made a smooth switch to physically based rendering, along with new research developments.

PHYSICALLY BASED SHADER DESIGN IN ARNOLD *(Langlands)*  
All about the design of `alShaders`, an open source library of production shaders for Arnold.

ART DIRECTION WITHIN PIXAR'S PHYSICALLY BASED LIGHTING SYSTEM *(Megibben and Rayani)*  
Hear how Pixar transitioned to a new lighting system, from an art production perspective.

## 3 Course Website

All course materials (presentations and notes) can be found at:  
`http://selfshadow.com/publications/s2014-shading-course`

## References

MCAULEY, HILL, H. L. K. N. P. A. M. H. V, 2013. Physically based shading in theory and practice. ACM SIGGRAPH 2013, July.

*LIGUM, Dept. I.R.O., Université de Montréal  
†Université de Lyon, CNRS