Team 2 Project Presentation

Janu Kim
Yiwen Mao
Tamana Pirzad

6 December 2023

Overview

1. A Learned Shape-Adaptive Subsurface Scattering Model (SIGGRAPH 2019)
    a. Review
    b. Improving idea
    c. Failure
2. Flexible SVBRDF Capture with a Multi-Image Deep Network (EGSR 2019)
    a. Brief introduction
    b. Limitation
    c. Improving idea & Failure
3. Conclusion
4. Role Division

First Try:

A Learned Shape-Adaptive Subsurface Scattering Model

by D. Vicini, V. Koltun, W. Jakob, SIGGRAPH 2019

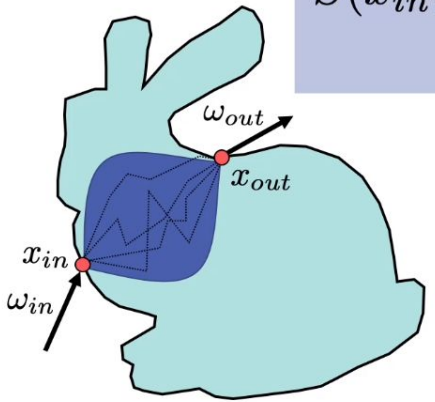
Review of The Paper

- Methods for implementing **subsurface scattering**
- **Inefficient** method (sampling RTE) **vs** **unrealistic** method (BSSRDF)

=> Kill two ~~birds~~rabbits with one stone using **Neural Network**

$$S(x_{in}, \omega_{in}, x_{out}, \omega_{out})$$

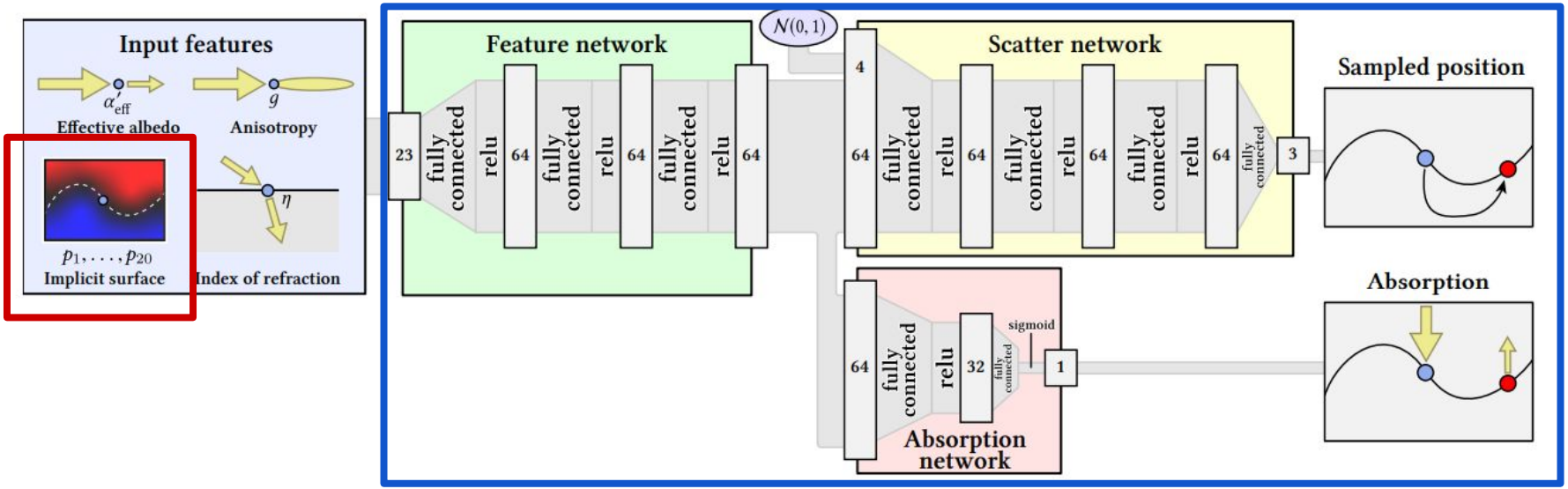
BSSRDF



Predict outgoing position and direction

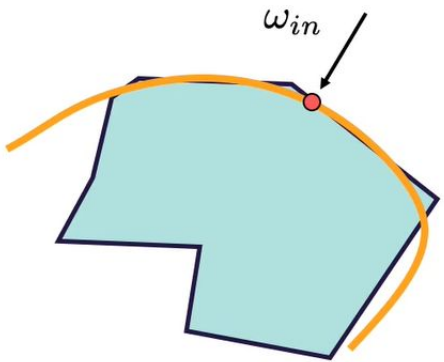
Review of The Paper

- They use **neural networks** to extract features, outgoing location, and absorption information
- However, for obtaining **geometric information**, they employ **polynomials** instead of neural networks

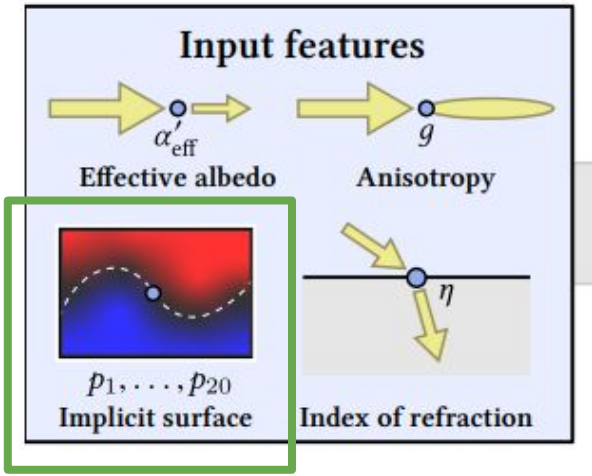


Review of The Paper

- They use **neural networks** to extract features, outgoing location, and absorption information
- However, for obtaining **geometric information**, they employ **polynomials** instead of neural networks
- Approximate **polynomial** -> **Coefficients** of polynomial as **input**



$$P(\mathbf{x}) = c_1 + c_2 x + c_3 y + \ldots c_{20} z^3$$



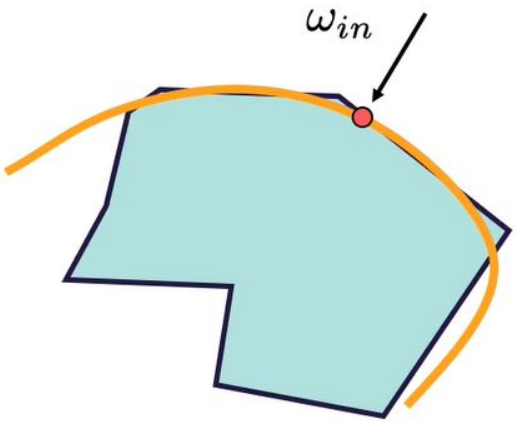
Review of The Paper

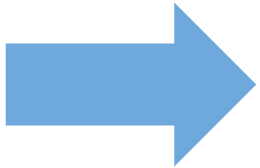
- They use **neural networks** to extract features, outgoing location, and absorption information
- However, for obtaining **geometric information**, they employ **polynomials** instead of neural networks
- Approximate **polynomial** -> **Coefficients** of polynomial as **input**

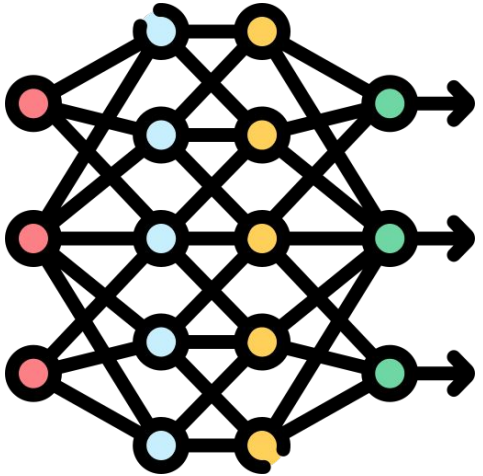
We may consider **replacing** the **polynomial** with a **neural network**.

Improving Idea

- Key idea: Replace **polynomial** with **neural network**
- The network is jointly trained with other networks(feature, scatter, absorption)
- If successful with **simple one**, we planned to explore **more complex one**



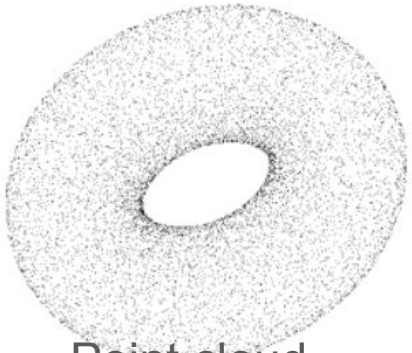




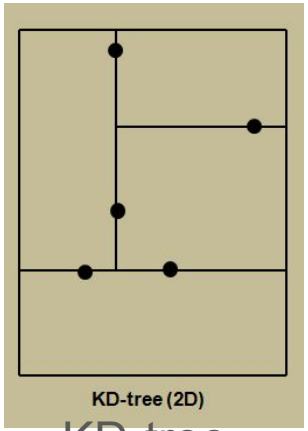
$$P(\mathbf{x}) = c_1 + c_2x + c_3y + \ldots c_{20}z^3$$

Improving Idea

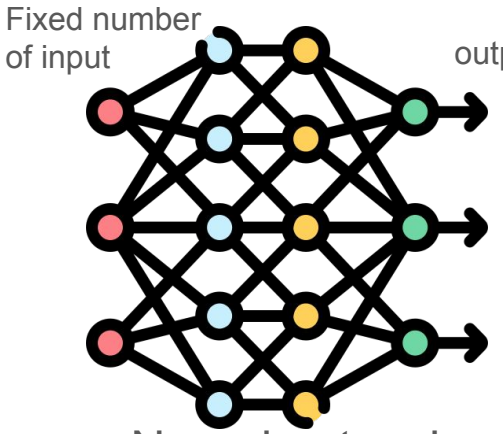
- **Input** in code: **KD-tree** data structure generated from **point clouds** obtained through 3D scanning objects
- **Polynomial**: KD-tree -> **polynomial fitted** => its **coefficients (20)**
- **Neural Network**: KD-tree -> a **fixed number of** random **points** from the tree => **output vector (dim:20)**



Point cloud



KD-tree



Neural network

https://commons.wikimedia.org/wiki/File:Point_cloud_torus.gif#/media/파일:Point_cloud_torus.gif
Voxel-based volume modelling of individual trees using terrestrial laser scanners - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/The-example-of-the-KD-tree-Algorithms-2D-3D_fig3_263937521 [accessed 3 Dec, 2023]

Improving Idea

Potential Benefits

- **Improved** prediction **quality**; able to learn **diverse data** representations
- Method **simplicity**

Potential Drawbacks

- **Lower** prediction **quality**
- **Decrease in speed**
- Risk of **overfitting**

Improving Idea

Potential Benefits

- Improved prediction quality; able to learn diverse data representations
- Method simplicity

Potential Drawbacks

- Lower prediction quality
- Decrease in speed
- Risk of overfitting

Reason for Failure: Outdated Version

[Requirements]

Mitsuba renderer 0.6

Python 2.7.x

Scons 2.x

Visual Studio 2010

```
@misc{Mitsuba,
    Author = {Wenzel Jakob},
    Year = {2010},
    Note = {http://www.mitsuba-renderer.org},
    Title = {Mitsuba renderer}
}
```

Challenges in **downloading** due to outdated versions

Errors arose from the installation of a **slightly newer version**

Reason for Failure: Outdated Version

Compiling Mitsuba's dependencies on Windows is a laborious process; for convenience, there is a repository that provides them in precompiled form. To use this repository, clone it using Mercurial and rename the directory so that it forms the `dependencies` subdirectory inside the main Mitsuba directory, i.e. run something like

```
C:\>cd mitsuba
C:\mitsuba\>hg clone https://www.mitsuba-renderer.org/hg/dependencies_windows
C:\mitsuba\>rename dependencies_windows dependencies
```

There are a few other things that need to be set up: make sure that your installation of Visual Studio is up to date, since Mitsuba binaries created with versions prior to Service Pack 1 will crash.

Next, you will need to install Python 2.7.x (`www.python.org`) and SCons[4] (`http://www.scons.org`, any 2.x version will do) and ensure that they are contained in the `%PATH%` environment variable so that entering `scons` on the command prompt (`cmd.exe`) launches the build system.

[4] Note that on some Windows machines, the SCons installer generates a warning about not finding Python in the registry. In this case, you can instead run `python setup.py install` within the source release of SCons.

Reason for Failure: Outdated Version

Compiling Mitsuba's dependencies on Windows is a laborious process; for convenience, there is a repository that provides them in precompiled form. To use this repository, clone it using Mercurial and rename the directory so that it forms the `dependencies` subdirectory inside the main Mitsuba directory, i.e. run something like

```
C:\>cd mitsuba
C:\mitsuba\>hg clone https://www.mitsuba-renderer.org/hg/dependencies_windows
C:\mitsuba\>rename dependencies_windows dependencies
```

Service Temporarily Unavailable

The server is temporarily unable to service your request due to maintenance downtime or capacity problems. Please try again later.

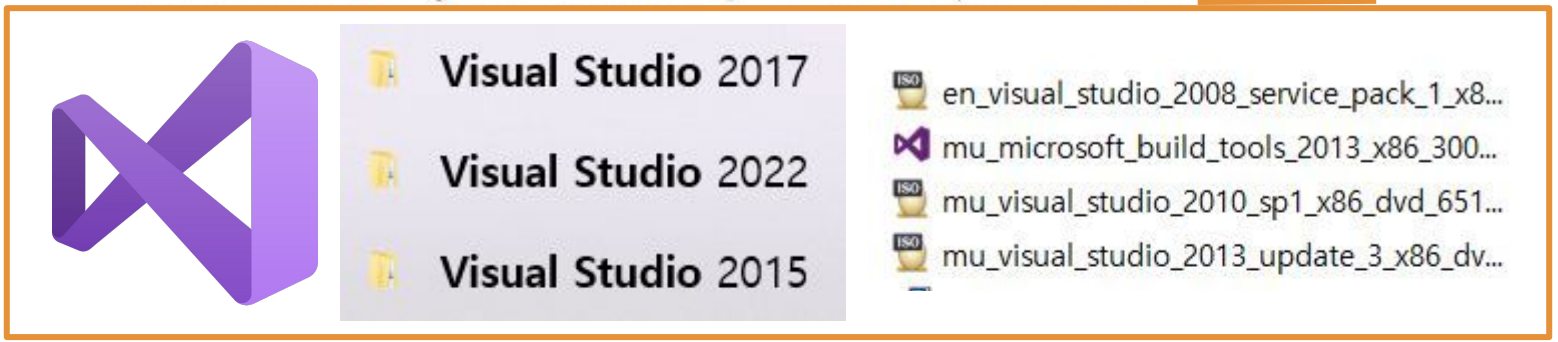
Apache/2.2.22 (Debian) Server at www.mitsuba-renderer.org Port 443

Reason for Failure: Outdated Version

Compiling Mitsuba's dependencies on Windows is a laborious process; for convenience, there is a repository that provides them in precompiled form. To use this repository, clone it using Mercurial and rename the directory so that it forms the `dependencies` subdirectory inside the main Mitsuba directory, i.e. run something like

```
C:\>cd mitsuba
C:\mitsuba\>hg clone https://www.mitsuba-renderer.org/hg/dependencies_windows
C:\mitsuba\>rename dependencies_windows dependencies
```

There are a few other things that need to be set up: make sure that your installation of Visual Studio



Reason for Failure: Outdated Version

Release version	Release date
Python 2.6.7	June 3, 2011
Python 2.5.6	May 26, 2011
Python 3.2.0	Feb. 20, 2011
Python 2.7.1	Nov. 27, 2010

Next, you will need to install Python 2.7.x (`www.python.org`) and SCons[4] (`http://www.scons.org`, any 2.x version will do) and ensure that they are contained in the `%PATH%` environment variable so that entering `scons` on the command prompt (`cmd.exe`) launches the build system.

[4] Note that on some Windows machines, the SCons installer generates a warning about not finding Python in the registry. In this case, you can instead run `python setup.py install` within the source release of SCons.

Reason for Failure: Outdated Version

- Numerous **errors** occurred without clear reasons.
- Despite substantial **efforts**, we encountered **difficulties** in **building** the **Mitsuba 0.6** renderer

```
!pip3 install mitsuba

Requirement already satisfied: mitsuba in c:\user
p0\localcache\local-packages\python310\site-packa
Requirement already satisfied: drjit==0.4.3 in c:
kfra8p0\localcache\local-packages\python310\site-
```

```
import mitsuba as mi

---------------------------------------
ModuleNotFoundError
```

```
D:\mitsuba>scons -V
D:\ProgramFiles\python3.10\Scripts\scons.py:99: DeprecationWarning:
pkg_resources is deprecated as an API. See
https://setuptools.pypa.io/en/latest/pkg_resources.html
 import pkg_resources
SCons import failed. Unable to find engine files in:
```

```
D:\mitsuba>scons
Fatal Python error: Py_Initialize: unable to load the file system codec
ModuleNotFoundError: No module named 'encodings'

Current thread 0x00000c08 (most recent call first):

D:\mitsuba>C:\Users\Lavinia\AppData\Local\Programs\Python\Python36\python.exe

scons: *** No SConstruct file found.
```

```
C:\Users\Lavinia\Desktop\KAIST\ICG\mitsuba>C:\Python27\Scripts\scons.bat
scons: Reading SConscript files ...

Visual Studio compiler found - C/C++ compilers most likely not set correctl

\KAIST\ICG\mitsuba\SConstruct", line 12, in <module>
sers\Lavinia\Desktop\KAIST\ICG\mitsuba\config.py"

3 not installed.  C/C++ compilers are most likely not set correctly.

\KAIST\ICG\mitsuba\build\SConscript.configure", line 96, in <module>
```

Reason for Failure: Outdated Version

Email to TA

Can we get some **advice** about how to **build Mitsuba0.6**? Is it problem of version?

I **don't** have experience working with **Mitsuba0.6**, where my work is based on the recent **Mitsuba3**

Also, python 2.7 is very **outdated**

Ask to Classmates

Does anyone know how to **build Mitsuba0.6**?

I tried to build it, but it's very **difficult**. We now do **another project without Mitsuba.**

Reason for Failure: Outdated Version

Email to TA

Can we get some **advice** about how to **build Mitsuba0.6**? Is it problem of version?

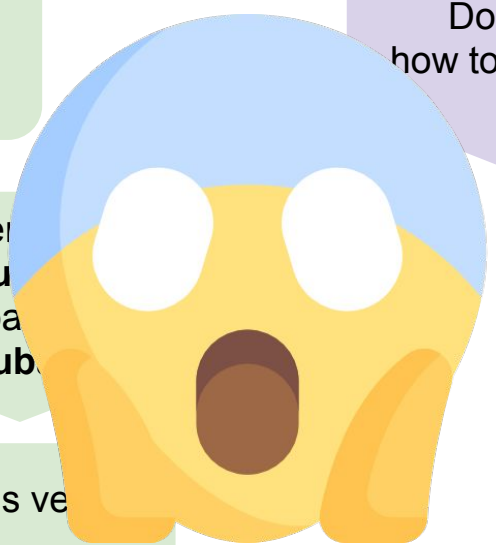
I **don't** have exper working with **Mitsu** where my work is ba the recent **Mitsub**

Also, python 2.7 is ve **outdated**

Ask to Classmates

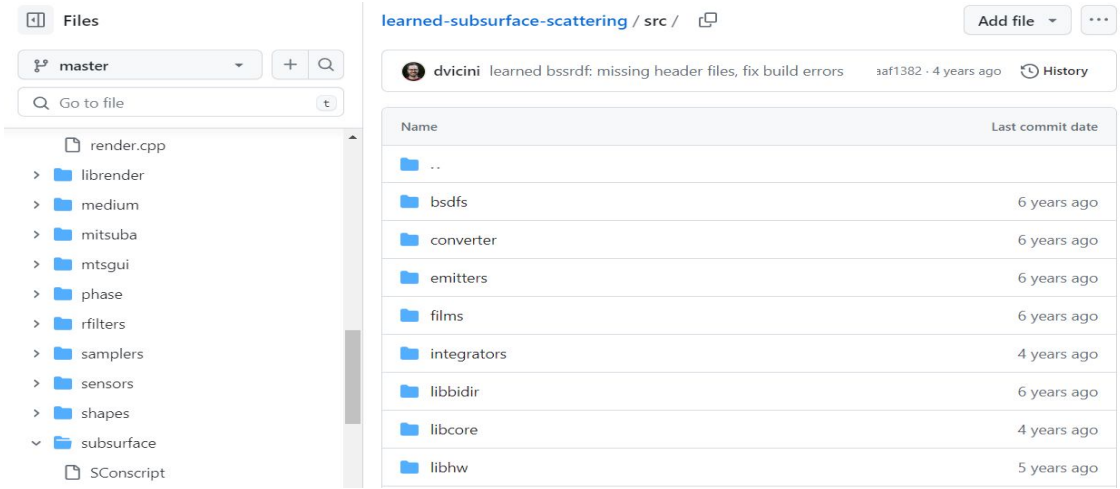
Does anyone know how to **build Mitsuba0.6**?

I tried to build it, but it's very **difficult**. We now do **another project without Mitsuba.**



Reason for Failure: Huge & complex code

- **Huge & complex project** with **difficult code**
  - files and functions utilized across different files
- High probability of **failing to revise** the code **correctly** even if the build was successful



Second Try:

Flexible SVBRDF Capture with a Multi-Image Deep Network

by Valentin Deschaintre, Miika Aittala, Fredo Durand, George Drettakis and Adrien Bousseau, EGSR 2019

Brief Introduction of the Paper

...

Li et al. 17, Deschaintre et al. 18, Li et al. 18

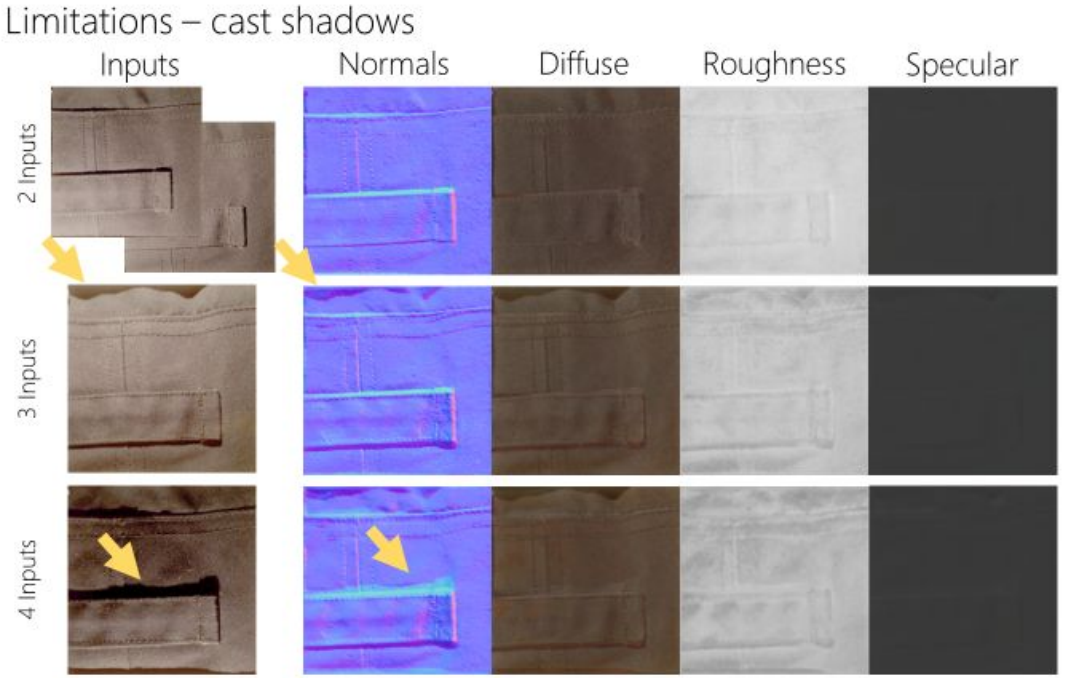
Schwartz et al. 2014.
University of Bonn's Dome II

Limitations Mentioned in the Paper

Use **normal maps** to represent orientation variations

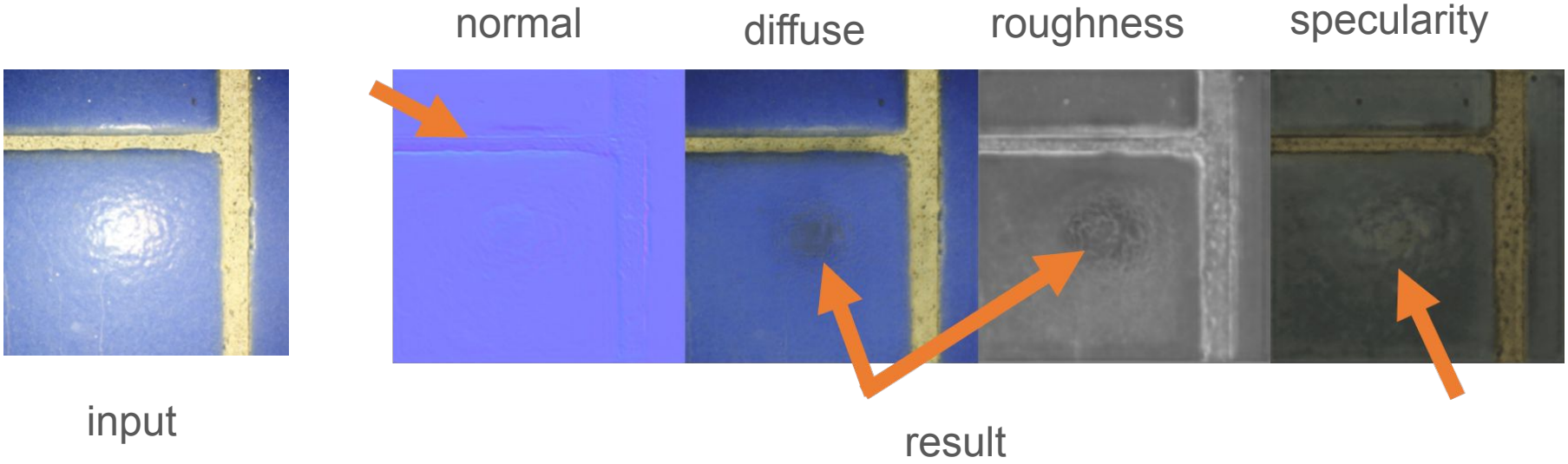
-> **Cannot** render **cast shadows and parallax**

-> The **network** does**n't** really **know** how to **represent these effects**



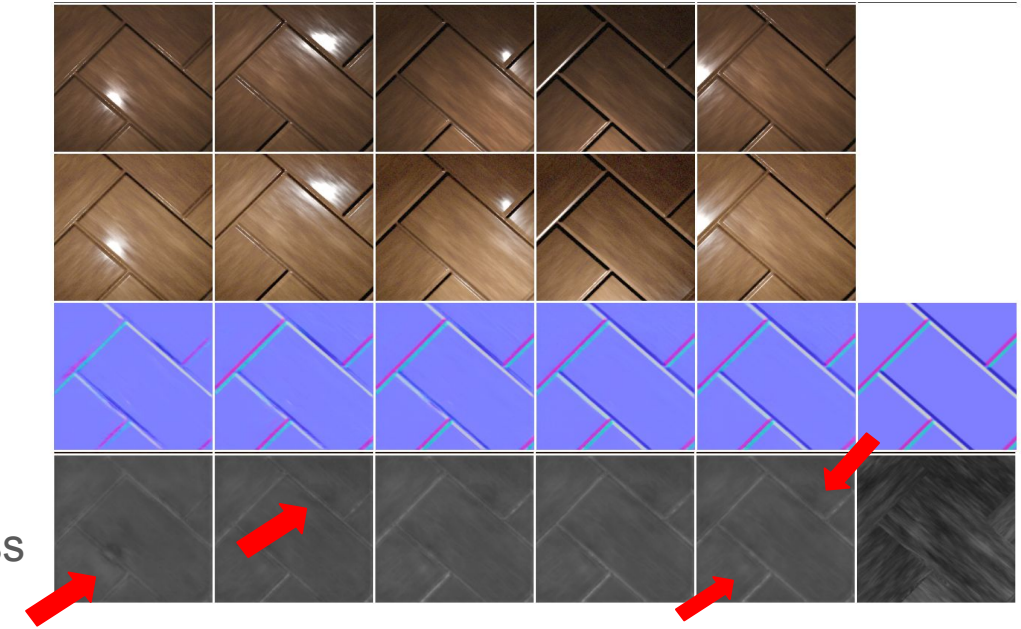
Limitations Mentioned in the Paper

- **One image may not be enough**



Limitation we found

- Using a **flash** -> **artifacts** as visible in diffuse and **roughness**
- **Problem** remains **even for 5 input images** (not only for 1 image)



Improving Idea

*dataset from:
https://team.inria.fr/graphdeco/projects/large-scale-materials/

- **Key idea**: **more (higher resolution) training data**
- **Failure**: training process got eliminated, newly trained weights* produce **wrong images** on same test data, but we don't know why

Conclusion: Learn from Failure

First Try:

- If implementation fails first few times, don’t waste time and move on
- Evaluate the difficulty of optimization before choosing a thesis
- Conceptualizing improvement is still possible by analysing paper and code
- Ensure that the code environment used is relatively new and easy to operate

Second Try:

- Mostly failed due to time constraints
- Idea can still be used for future work

Role Division

- Janu Kim
  - Analysis of both papers
  - Understanding core concepts
- Yiwen Mao
  - Old paper code compilation
  - Analysis of new paper
- Tamana Pirzad
  - New paper code compilation
  - Finding solution to new paper

Thank You :)

감사합니다! 谢谢! Bedankt!