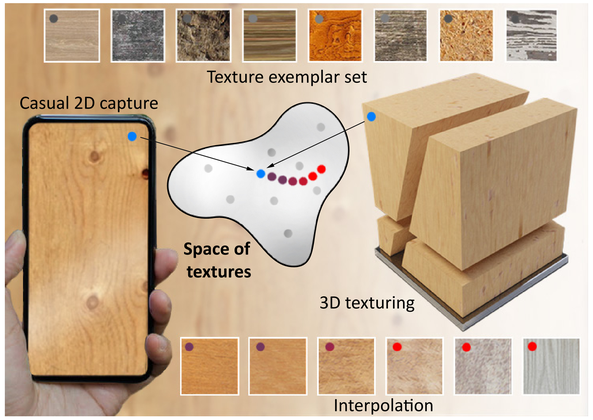
Learning a Neural 3D Texture Space from 2D Exemplars

Philipp Henzler[1] **Niloy J. Mitra**[1,2] **Tobias Ritschel**[1]

[1]University College London [2]Adobe Research

Motivation

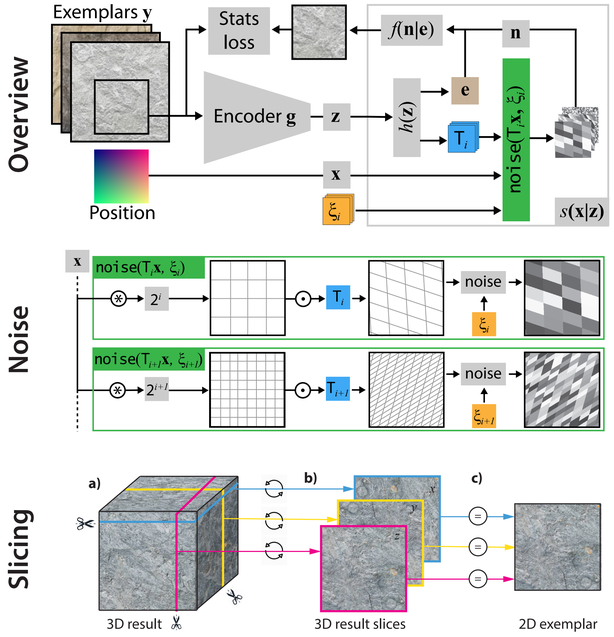


- **Input** is a **2D texture** which is captured by an **implicit field**, i.e. we can sample a new texture independent of **spatial resolution** and **shape**.
- **Output** is a **space** of **2D** or **3D** textures with following characteristics:
  Complete | Generative | Interpolatable | Continuous domain
  Diverse | Infinite zoom | Computationally efficient | Compact

Performance

Method	Diverse	Details	Speed	3D	Quality	Space	2D-to-3D
Perlin [1]	+	+	+	+	-	-	+
Perlin + transform [1]	+	+	+	+	-	-	+
CNN [2]	-	-	-	-	+	-	-
CNN + diversity [3]	+	-	-	-	-	-	-
MLP [4]	-	-	+	+	-	-	+
Ours + position	-	+	+	+	+	+	+

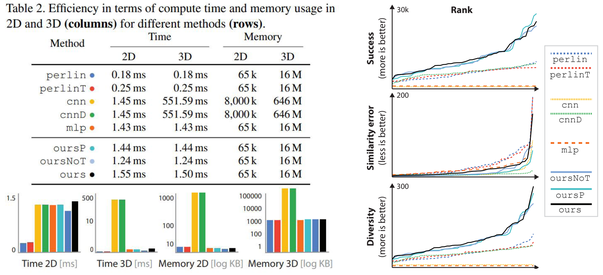
Method



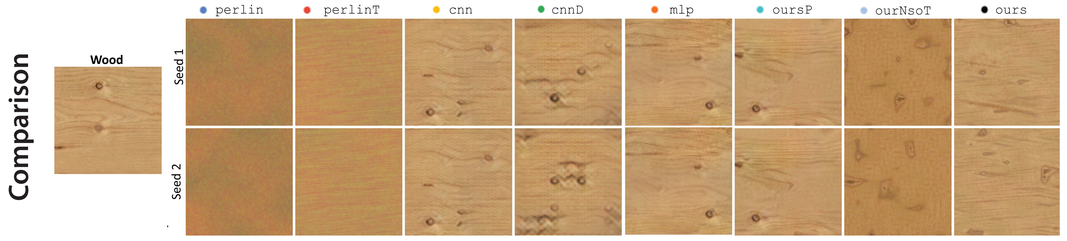
Quantitative Results

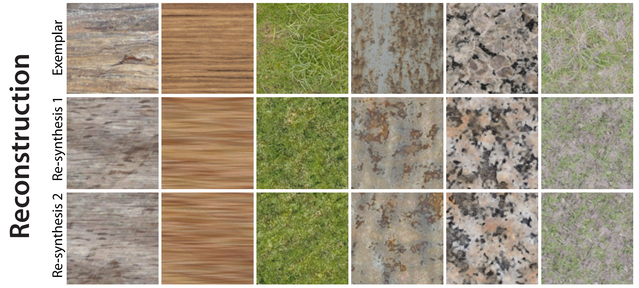
Table 2. Efficiency in terms of compute time and memory usage in 2D and 3D **(columns)** for different methods **(rows)**.

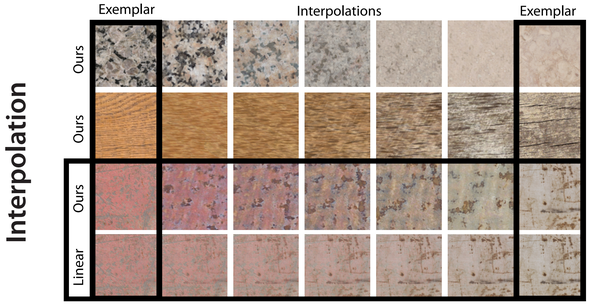
Method	Time 2D	Time 3D	Memory 2D	Memory 3D
perlin	0.18 ms	0.18 ms	65 k	16 M
perlinT	0.25 ms	0.25 ms	65 k	16 M
cnn	1.45 ms	551.59 ms	8,000 k	646 M
cnnD	1.45 ms	551.59 ms	8,000 k	646 M
mlp	1.43 ms	1.43 ms	65 k	16 M
oursP	1.44 ms	1.44 ms	65 k	16 M
oursNoT	1.24 ms	1.24 ms	65 k	16 M
ours	1.55 ms	1.50 ms	65 k	16 M

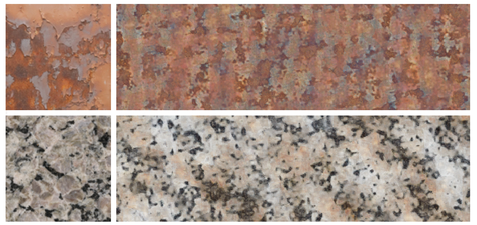


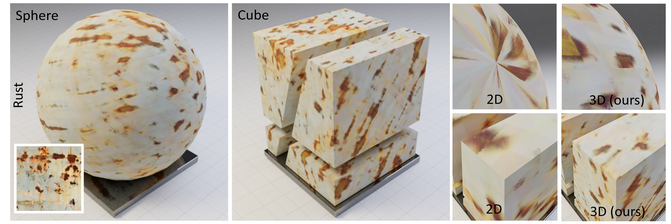
Qualitative Results











References

[1] Ken Perlin. An image synthesizer. In SIGGRAPH Comput. Graph., 1985.
[2] Dmitry Ulyanov, Vadim Lebedev, Andrea Vedaldi, and Victor S Lempitsky. Texture networks: Feed-forward synthesis of textures and stylized images. In ICML, 2016.
[3] Dmitry Ulyanov, Andrea Vedaldi, and Victor Lempitsky. Improved texture networks: Maximizing qualityand diversity in feed-forward stylization and texture synthesis. In CVPR, 2017
[4] Michael Oechsle, Lars Mescheder, Michael Niemeyer, Thilo Strauss, and Andreas Geiger. Texture fields: Learning texture representations in function space. In ICCV, 2019

Acknowledgements

This work was supported by the ERCStarting Grant SmartGeometry, a GPU donation by NVIDIA Corporation and a Google AR/VR Research Award.

Email: p.henzler@cs.ucl.ac.uk
Project page: tinyurl.com/wma2e3b
Personal page: henzler.github.io/