Can the **Depth Map** computation potential of **Stereo Images** be **transferred to** Mono **Acoustic Recordings?**

- Mapping Space with Time -

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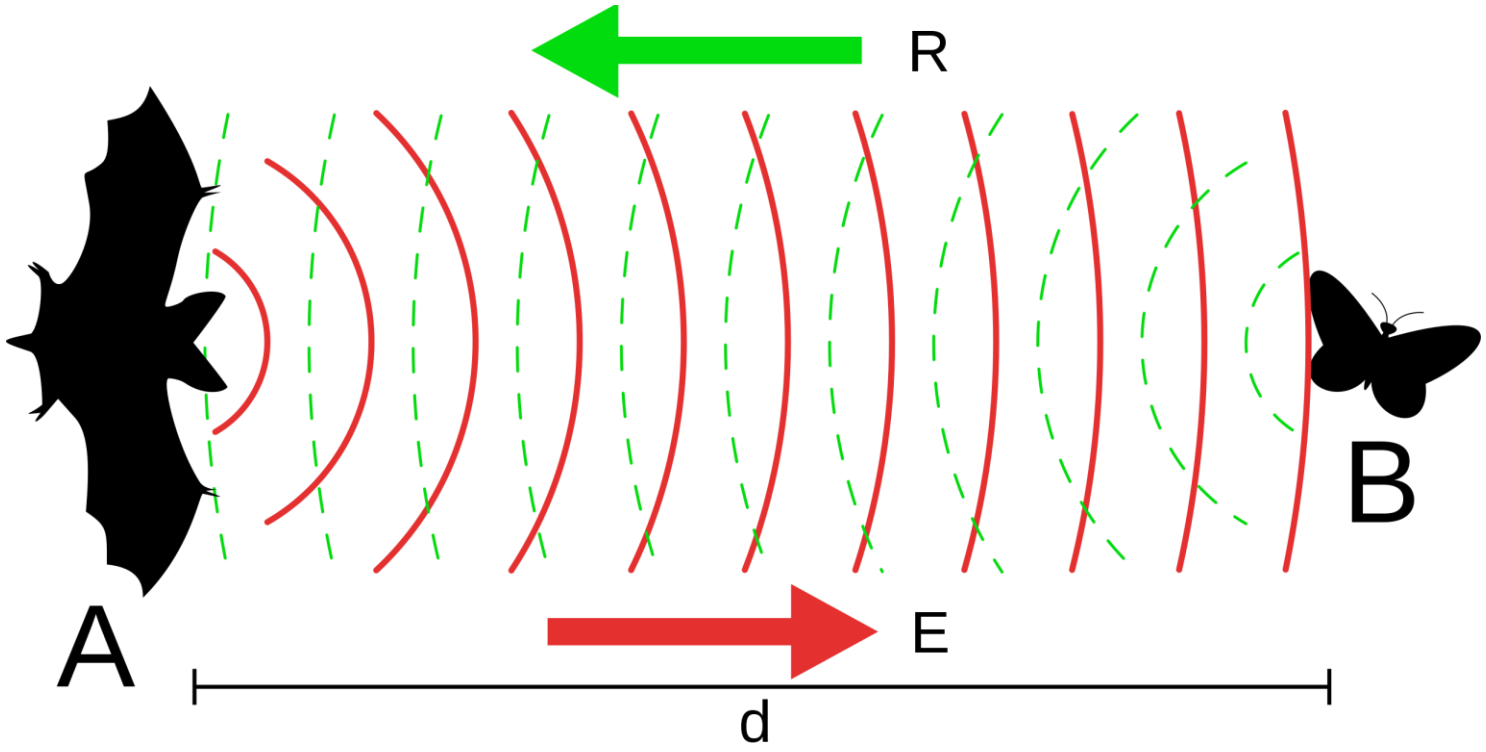
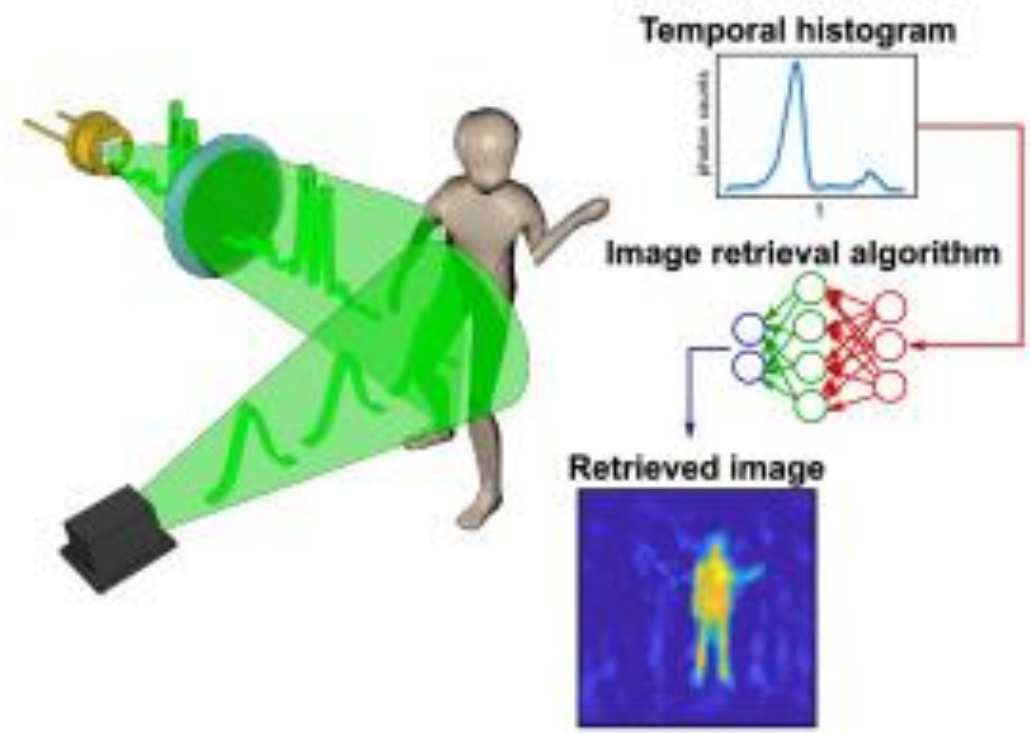
Computer Vision – *Computational Mathematics*
Universitat Autonoma de Barcelona 24/05/2022

Inspiration





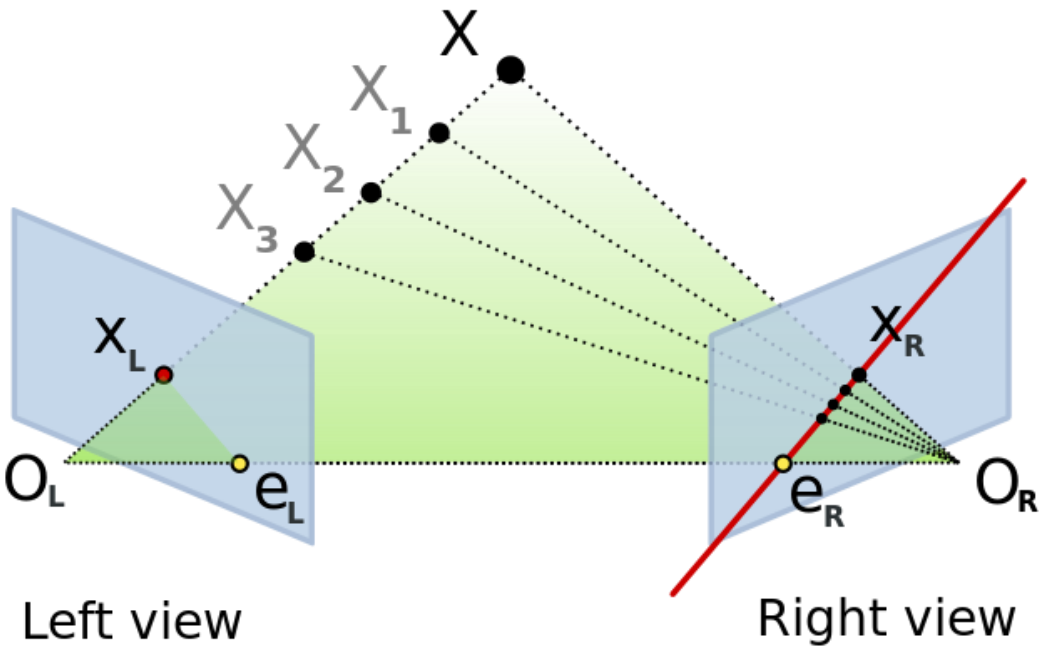
A. Turpin et al., ***"Spatial images from temporal data,"*** Optica 7, 900-905 **(2020)**

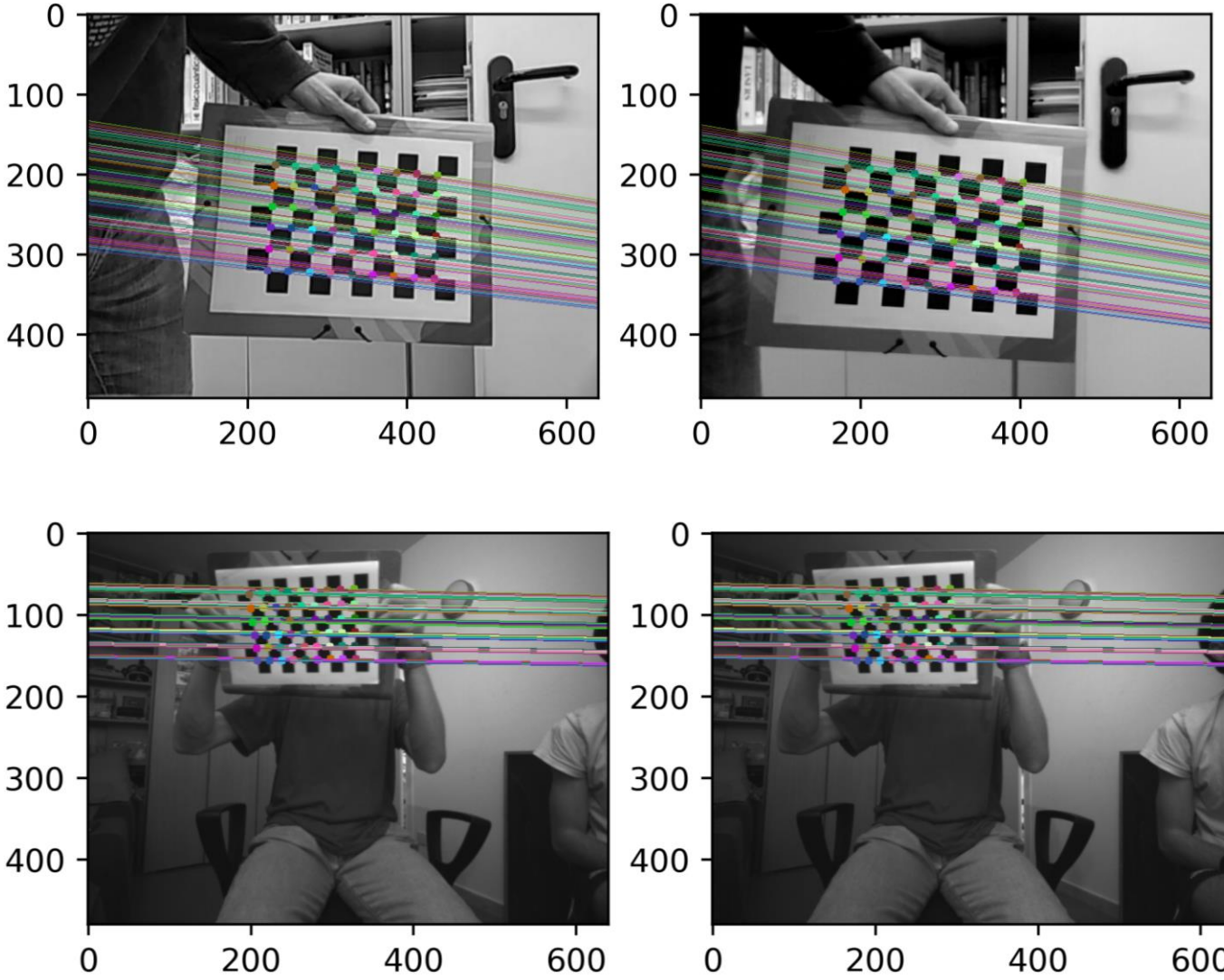
A. Turpin et al**.,"*3D imaging from multipath temporal echoes,"*** Phys. Rev. Lett. 126, 174301 **(2021)**

Depth Maps using Stereo Imaging

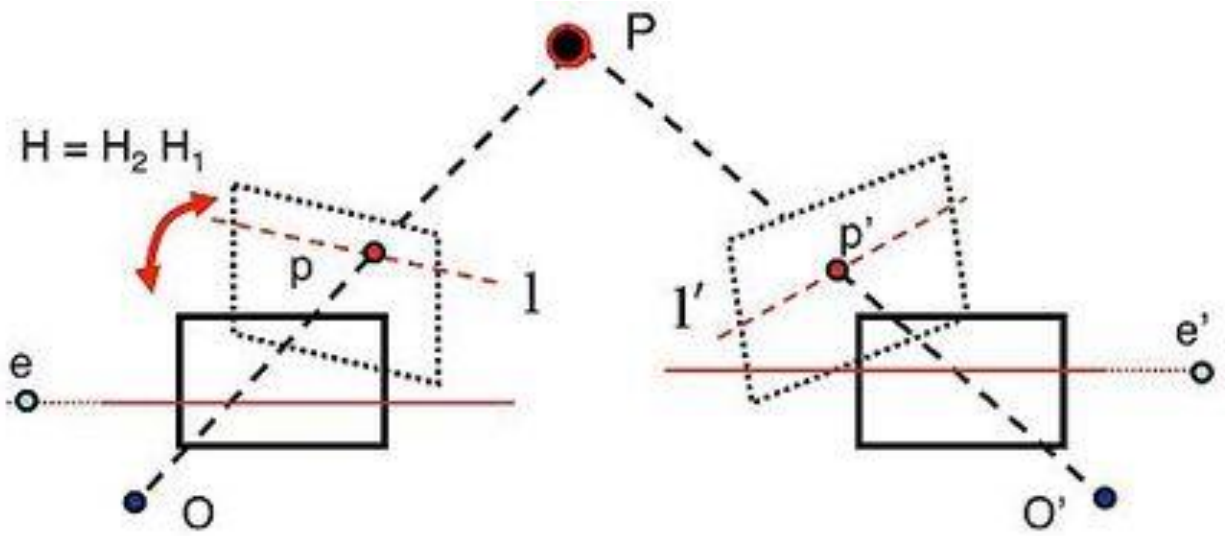
Camera Calibration (Intrinsics)

On Epipolar Lines...





On Image Rectification...



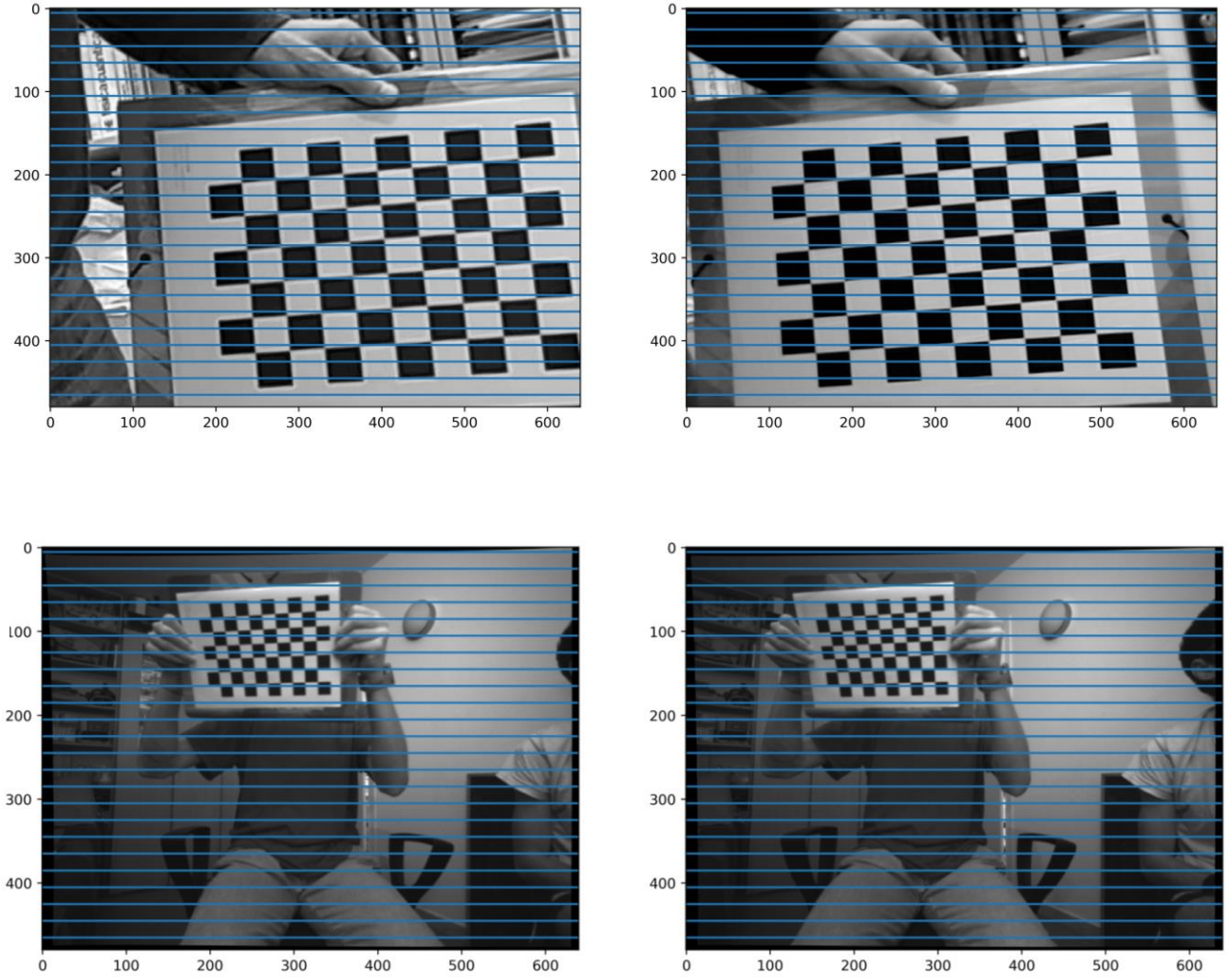
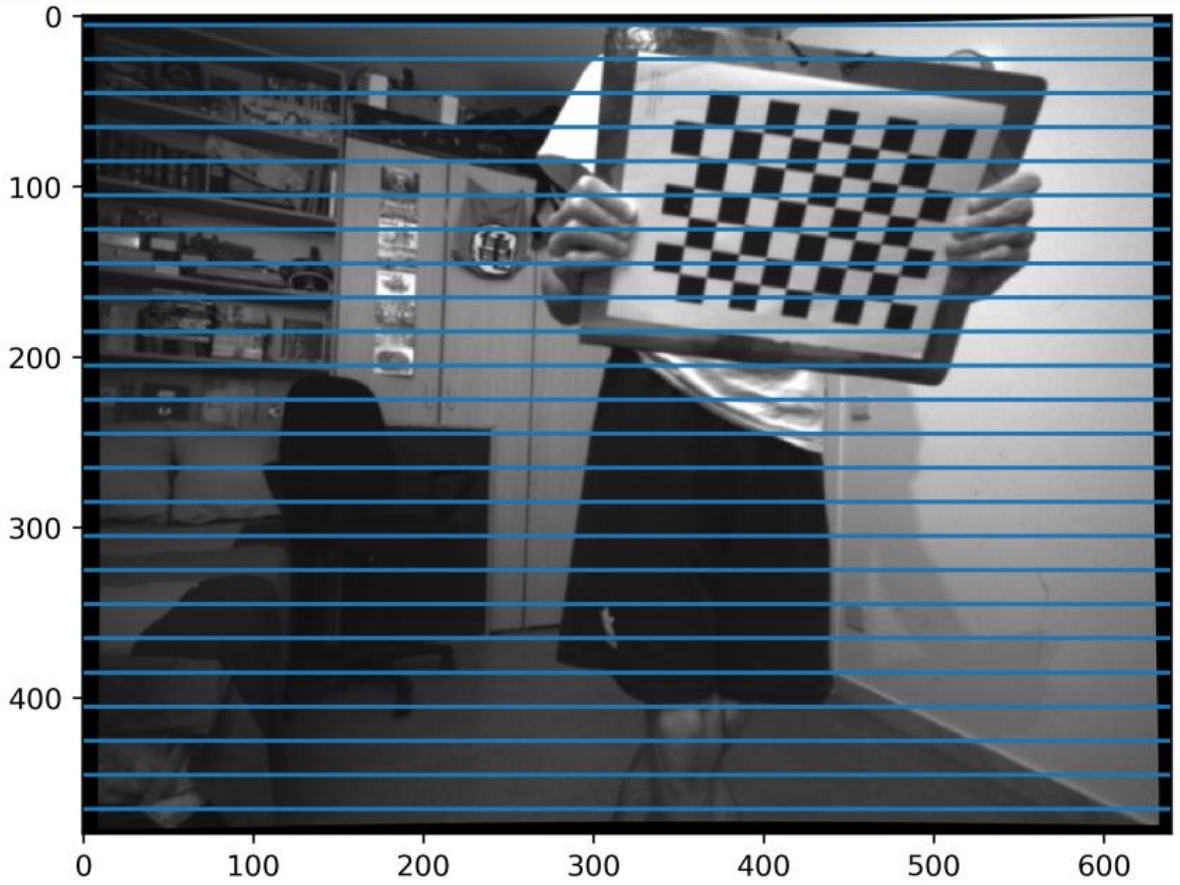
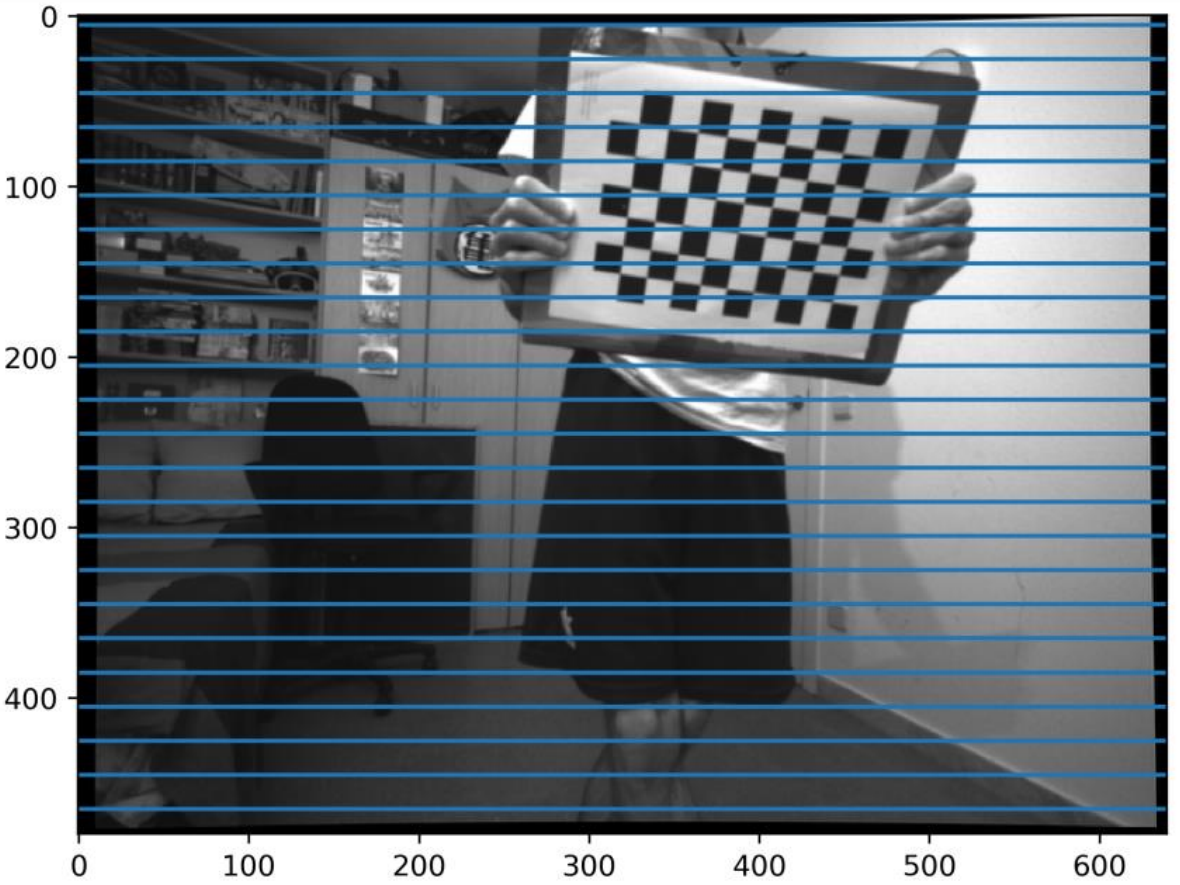


Image Rectification



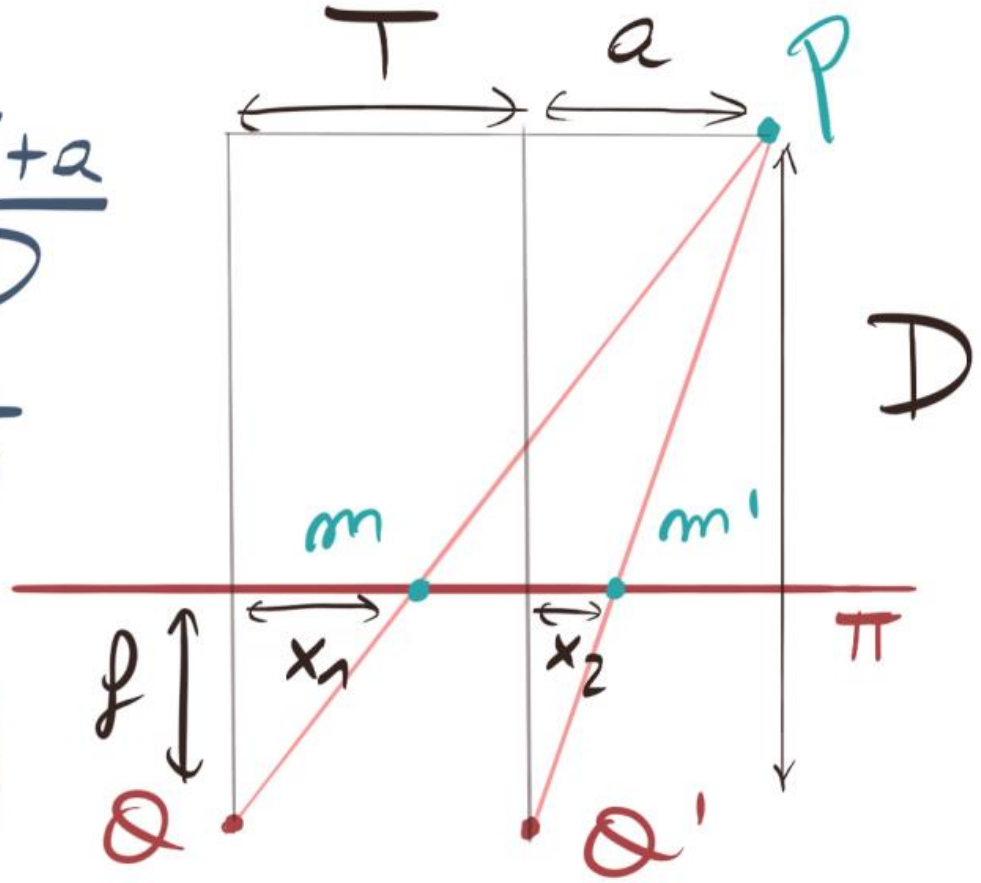


On Disparity to Depth...

$$\begin{cases} \frac{x_1}{f} = \frac{T+a}{D} \\ \frac{x_2}{f} = \frac{a}{D} \end{cases}$$

$$\Updownarrow$$

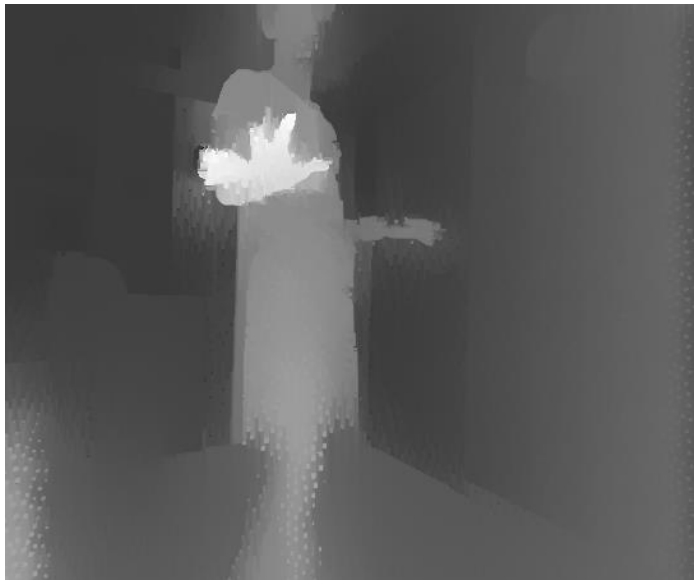
$$D = \frac{Tf}{x_1 - x_2}$$



Compute Disparity Maps

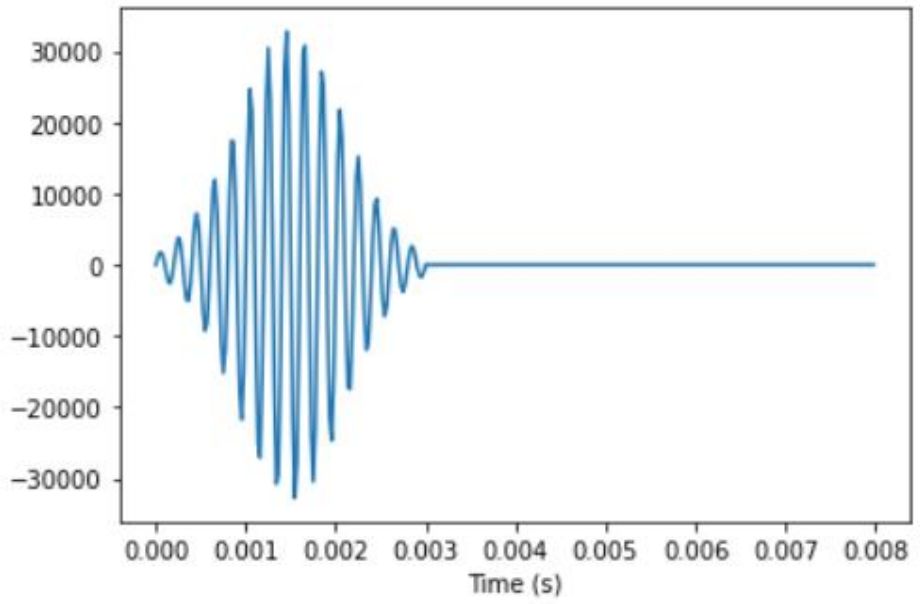
Post-processing WLS Filter

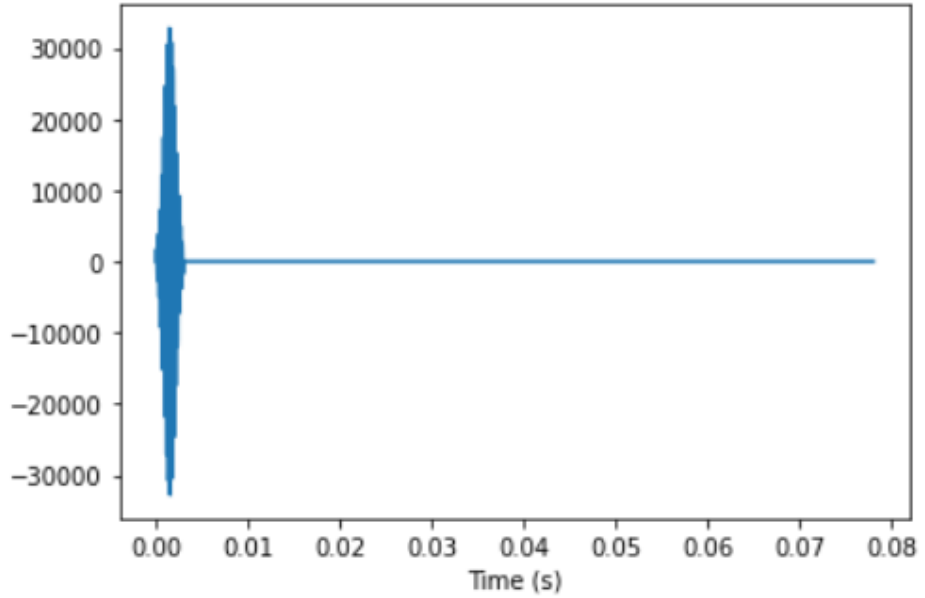
Generate Depth Maps!

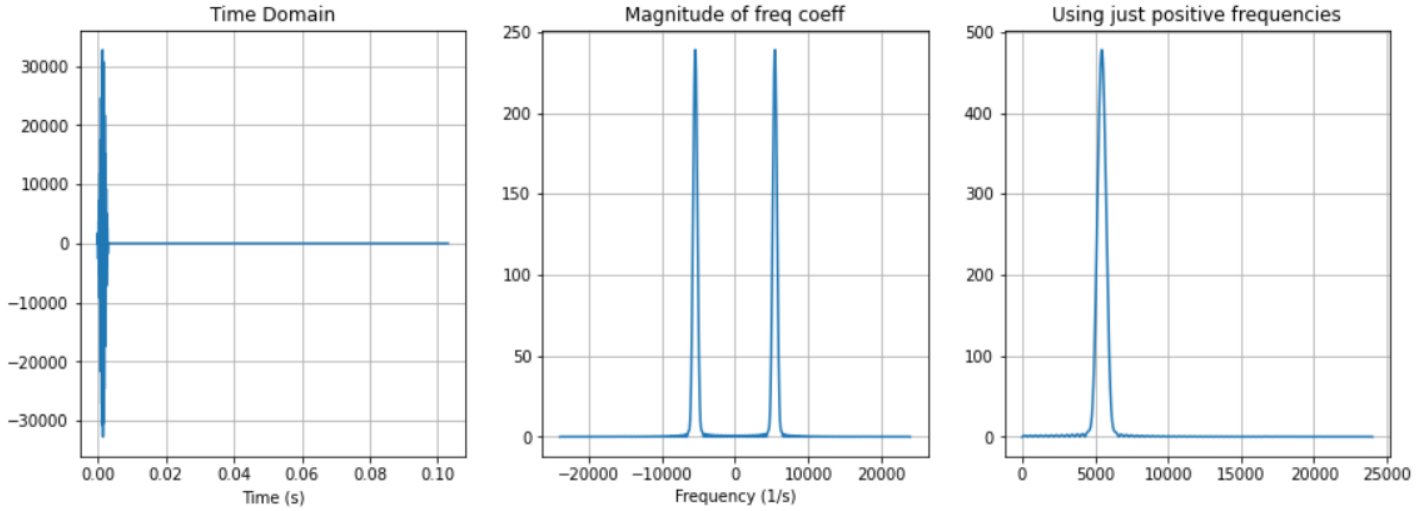


Sound Pulse Engineering

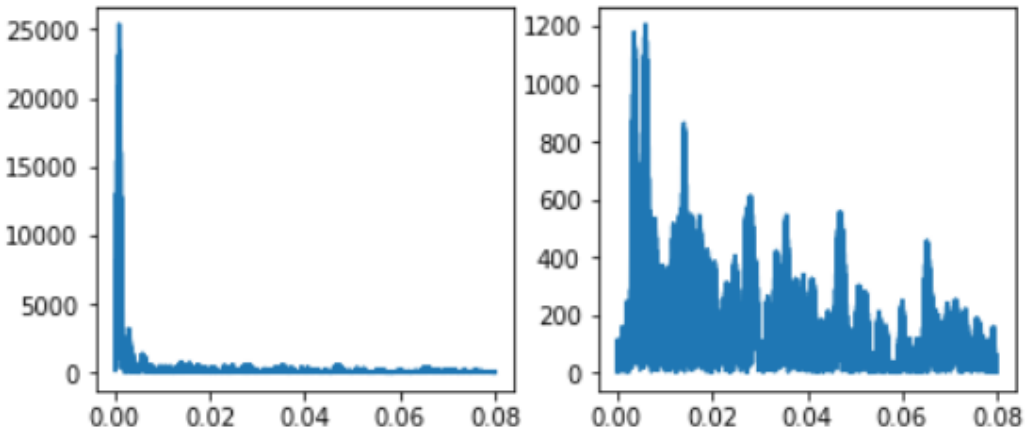
Emitted Pulse

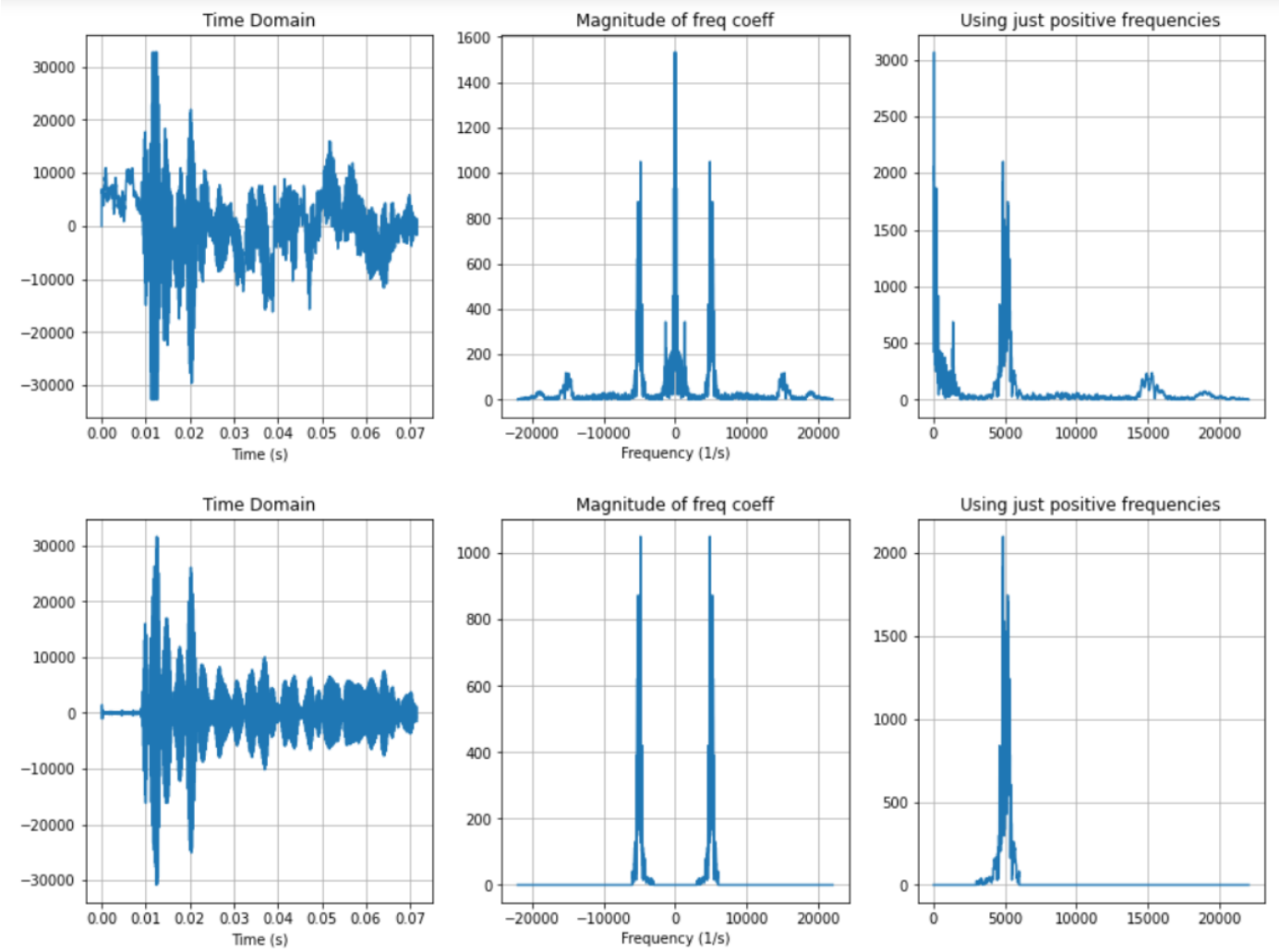




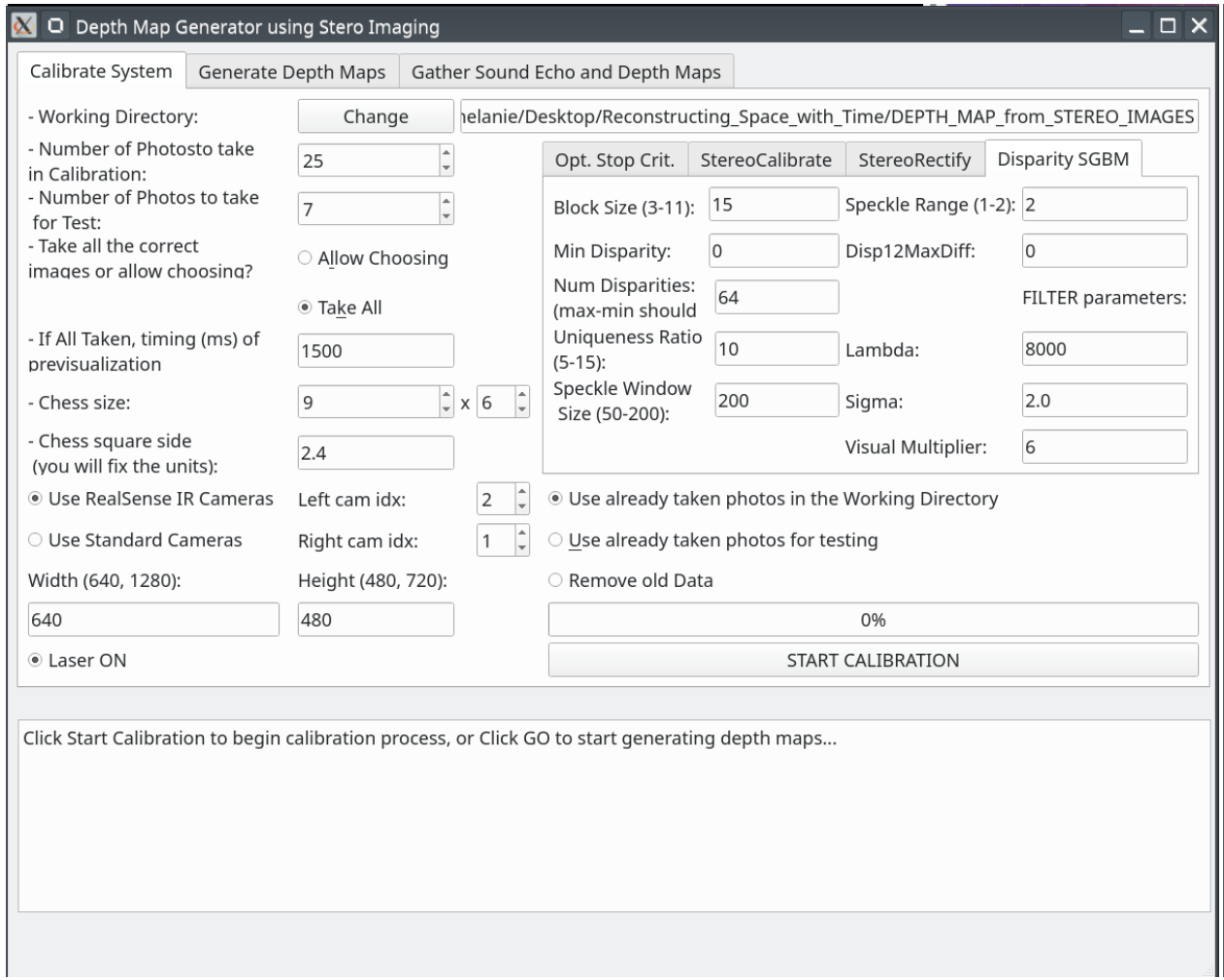


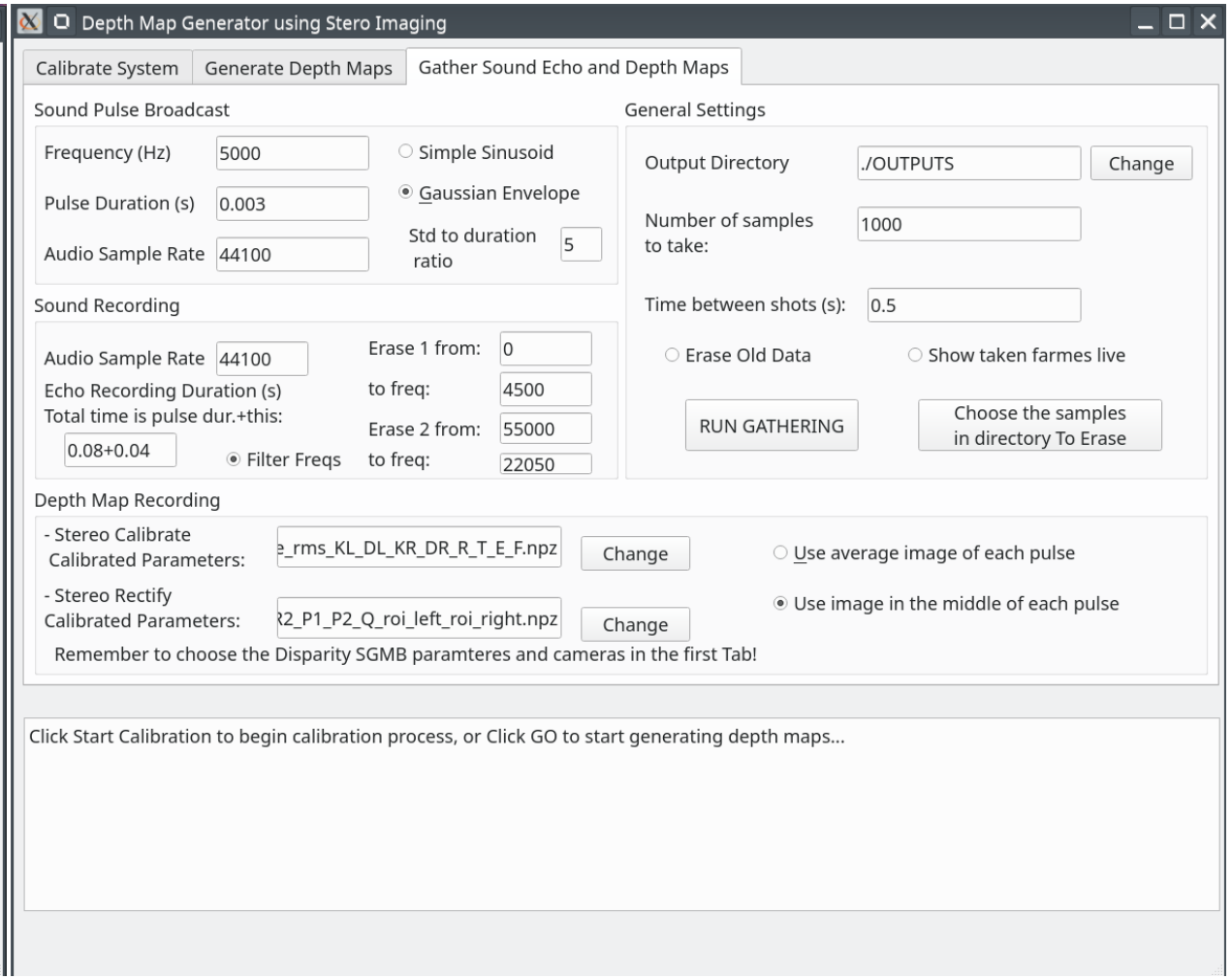
Recorded Sound





GUI for the Pipeline





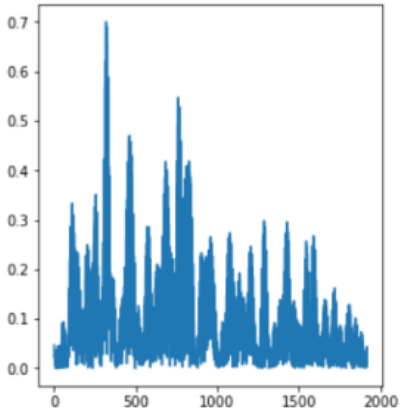
Generated Datasets

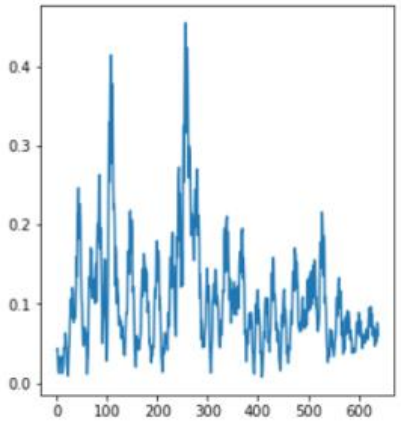
2 Set-ups, 3 Datasets

Setup A

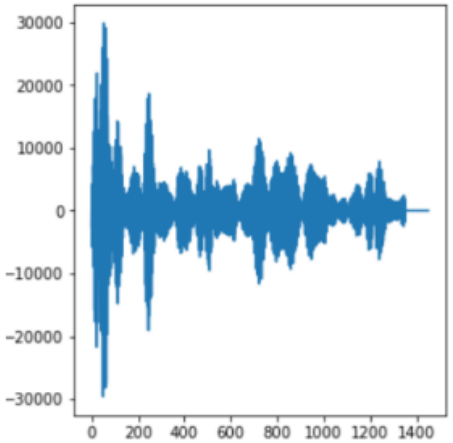
Setup B

Dataset A





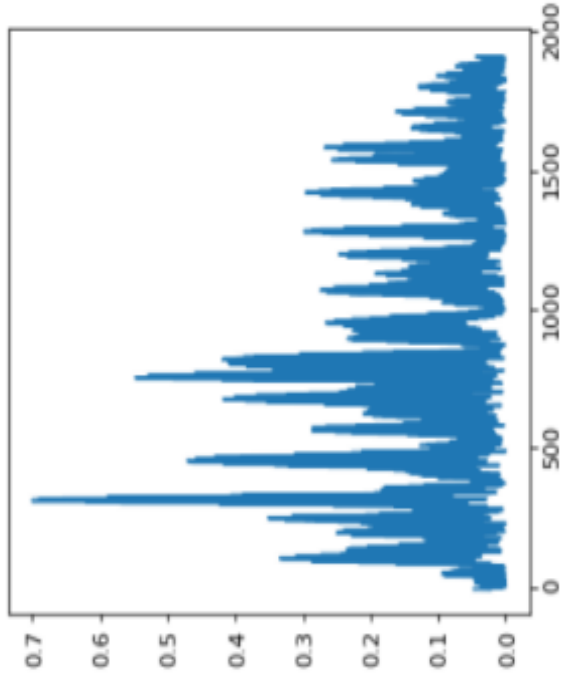
Dataset A'

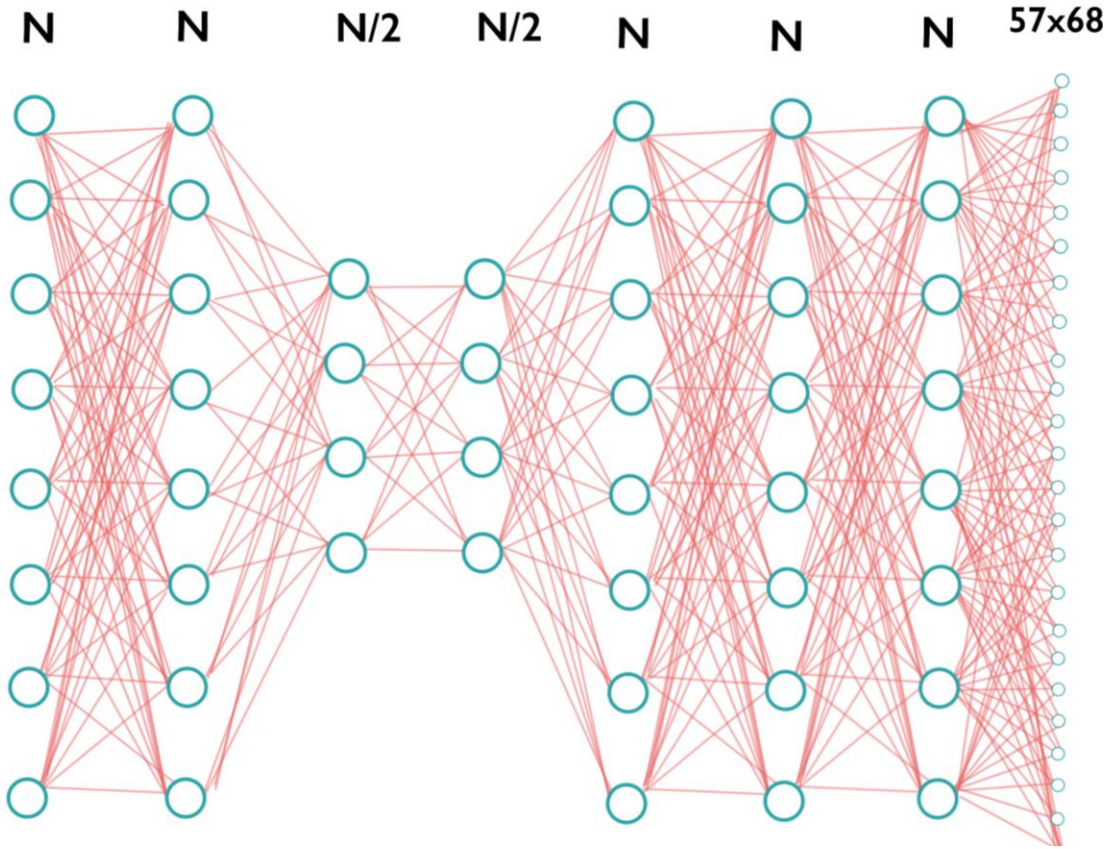


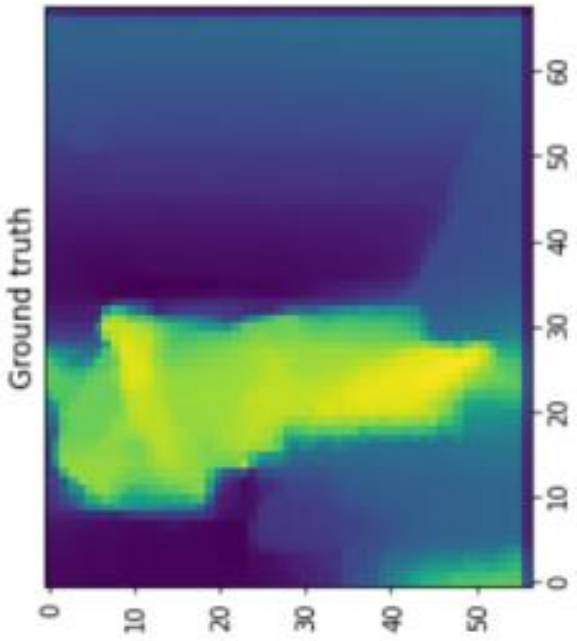
Dataset B

Employed Neural Networks

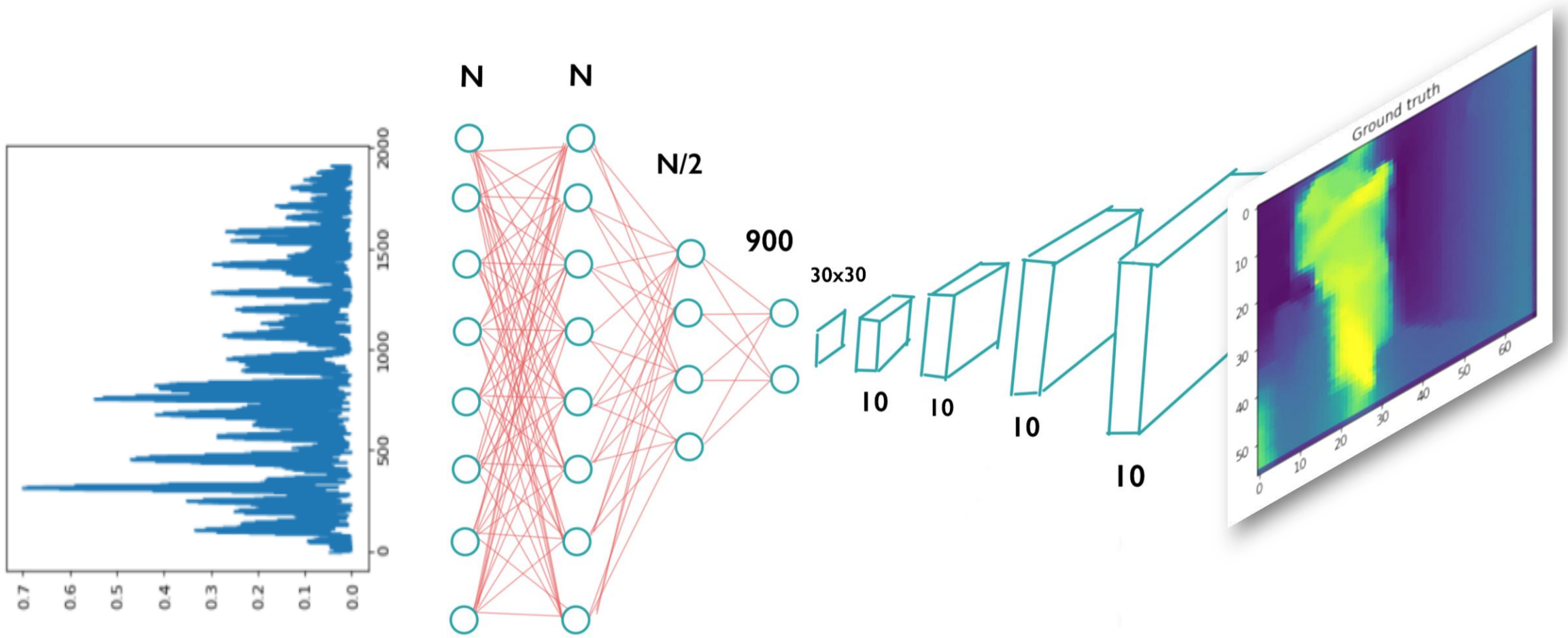
Fully^2 Connected





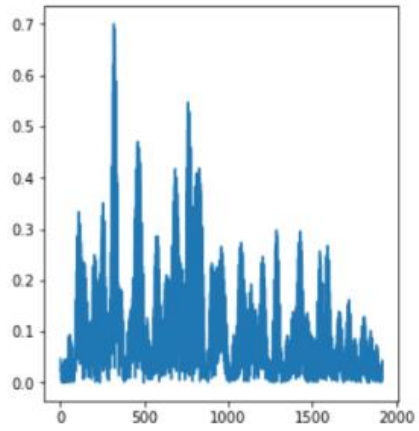


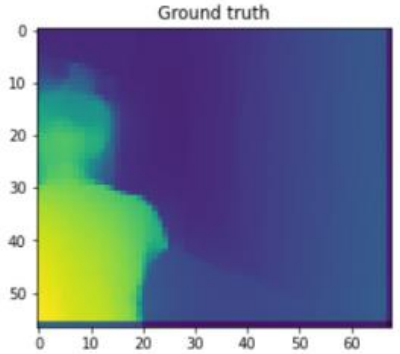
Fully Connected + (De)convolutional Layers

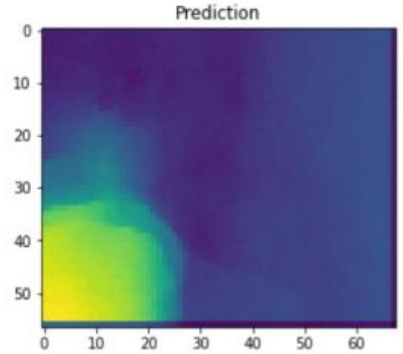


Results

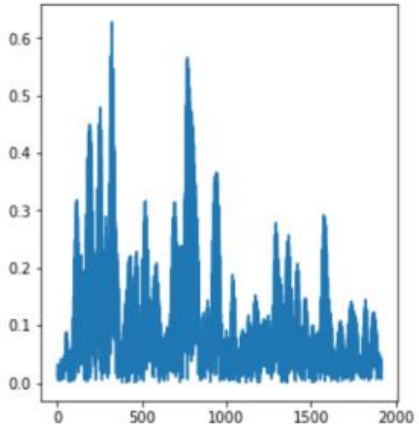
Dataset A

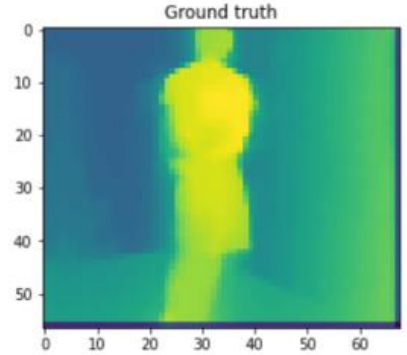


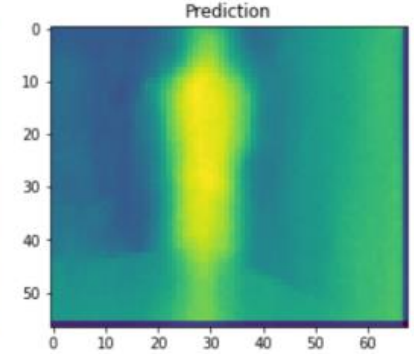




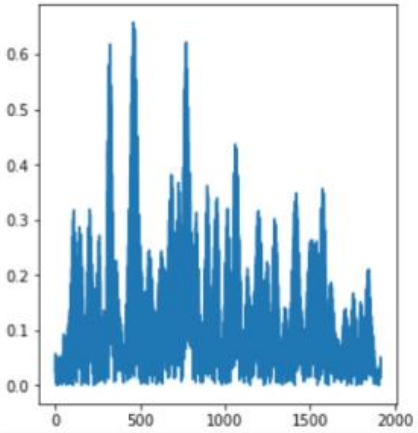
(a) Test set example 1, MLP

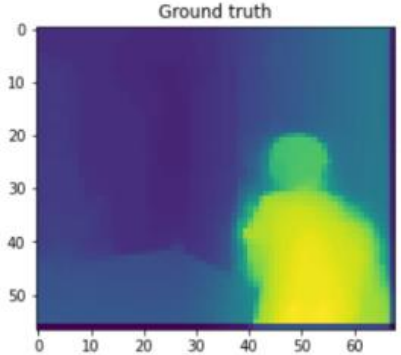


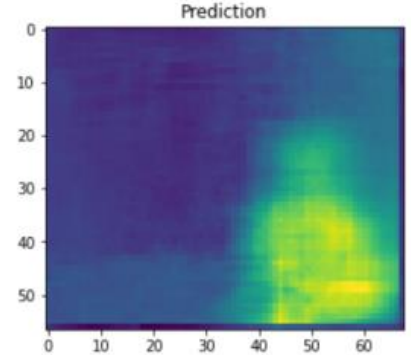




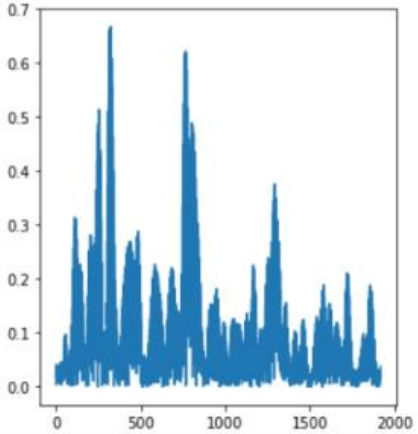
(b) Test set example 2, MLP

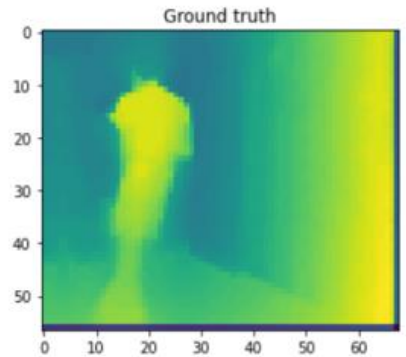


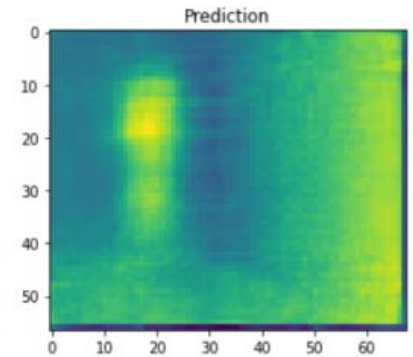




(c) Test set example 1, MLP+Deconv

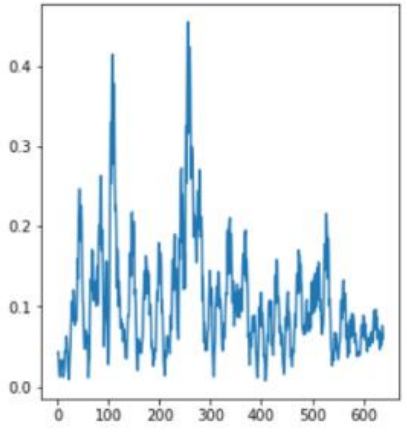


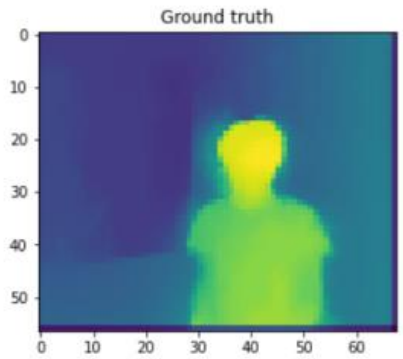


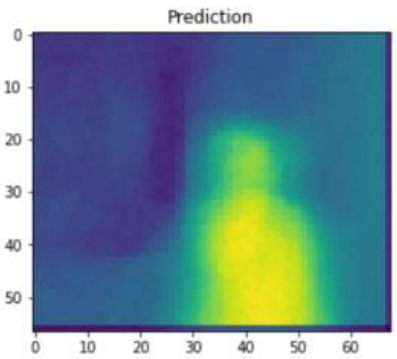


(d) Test set example 2, MLP+Deconv

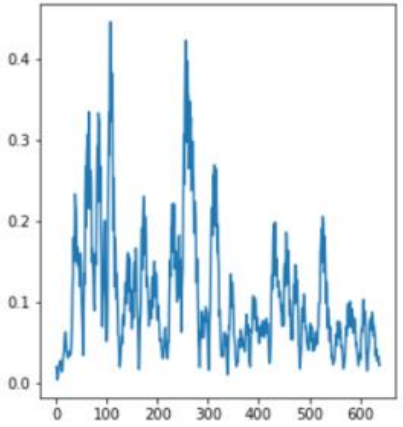
Dataset A’

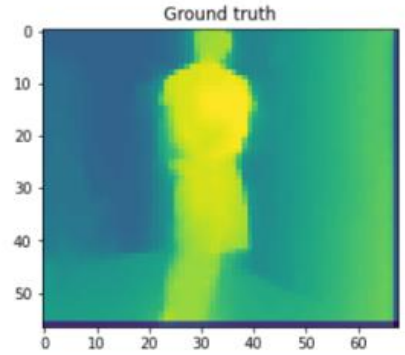


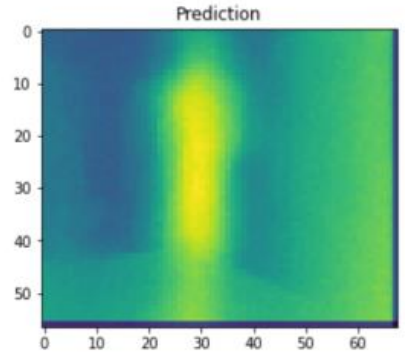




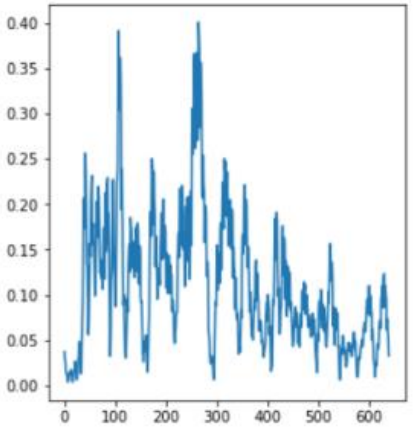
(a) Test set example 1, MLP

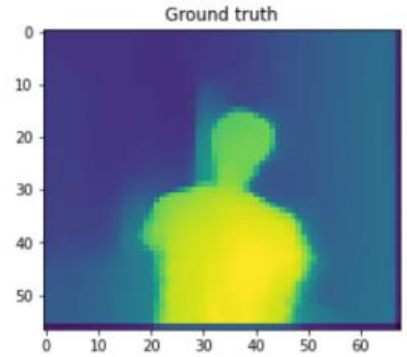


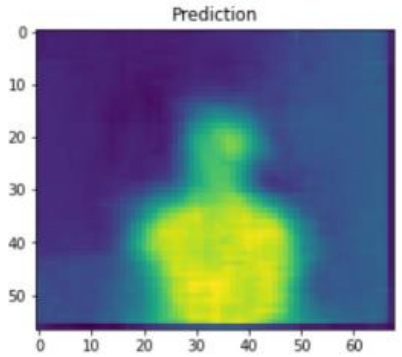




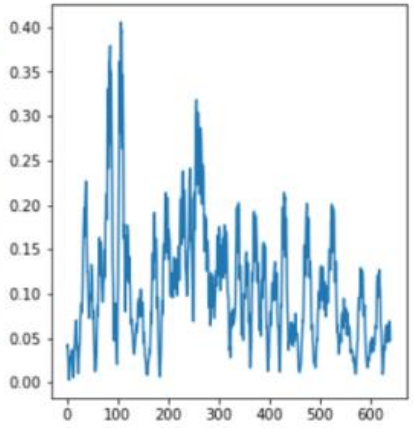
(b) Test set example 2, MLP

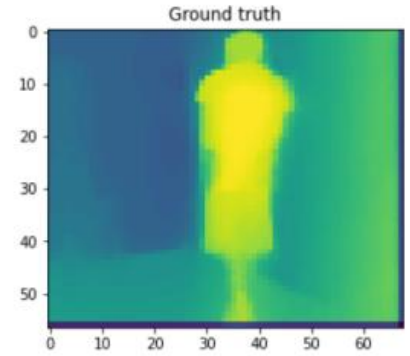


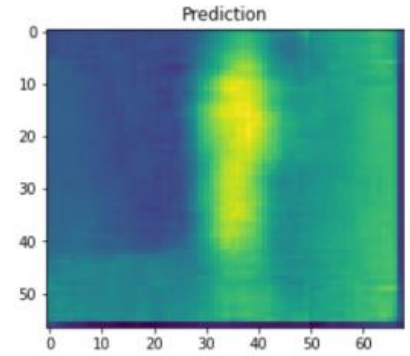




(c) Test set example 1, MLP+Deconv

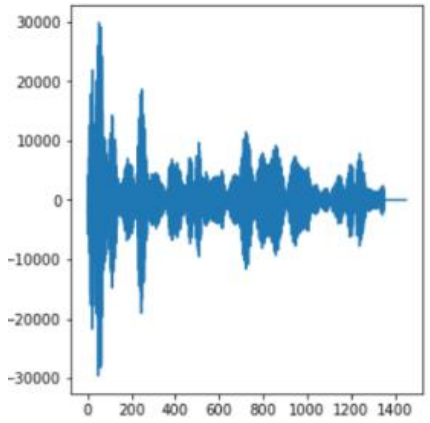


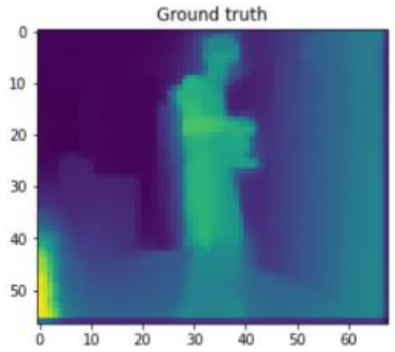


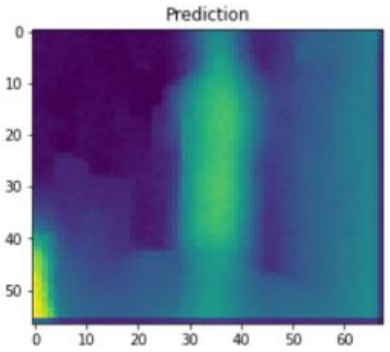


(d) Test set example 2, MLP+Deconv

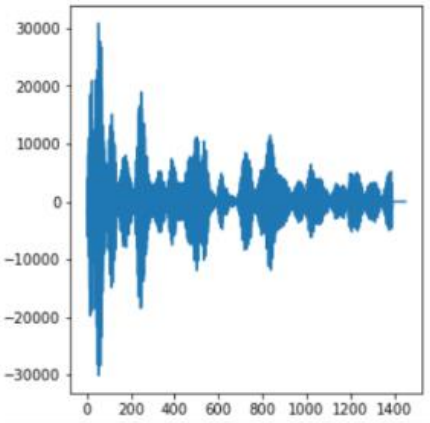
Dataset B

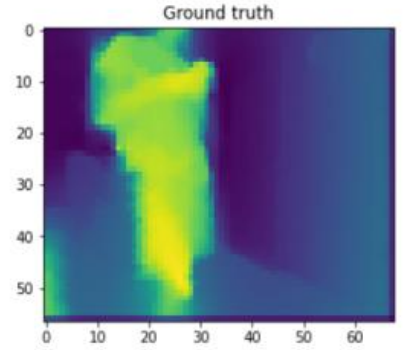


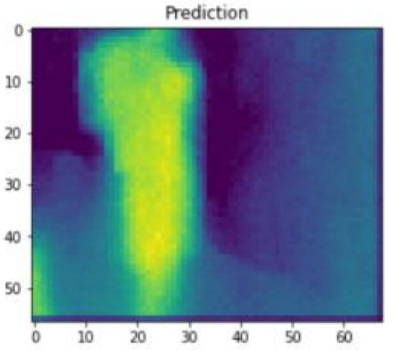




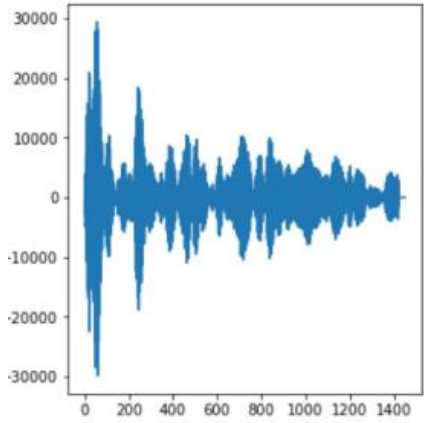
(a) Test set example 1, MLP

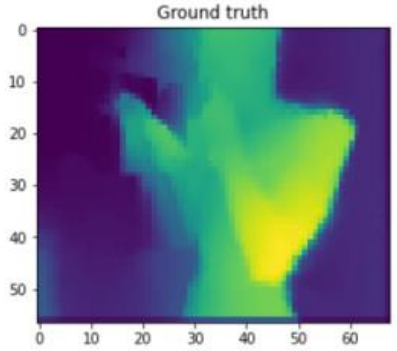


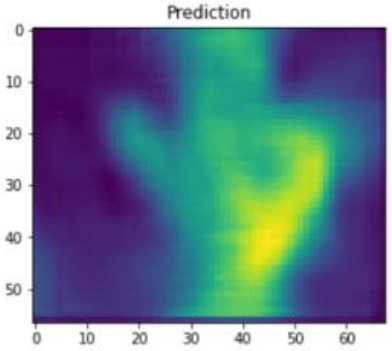




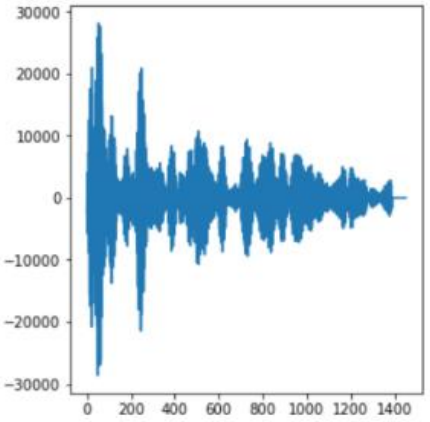
(b) Test set example 2, MLP

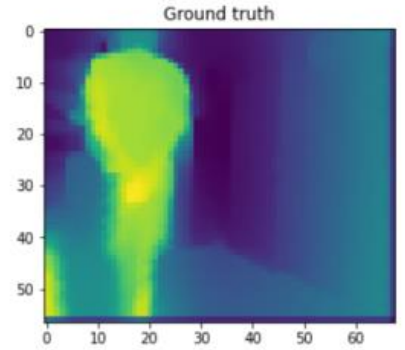


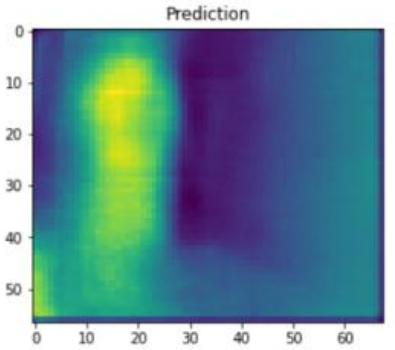




(c) Test set example 1, MLP+Deconv







(d) Test set example 2, MLP+Deconv

Metrics on Test Sets

Dataset	Network	Num. params.	MSE	SSIM
A	MLP	23.12e6	0.00088	0.930
A	MLP+Deconv	7.3e6	0.0012	0.901
A’	MLP	4.2e6	0.00093	0.915
A’	MLP+Deconv	2.02e6	0.0011	0.906
B	MLP	14.6e6	0.019	0.720
B	MLP+Deconv	4.3e6	0.021	0.660

Questions!