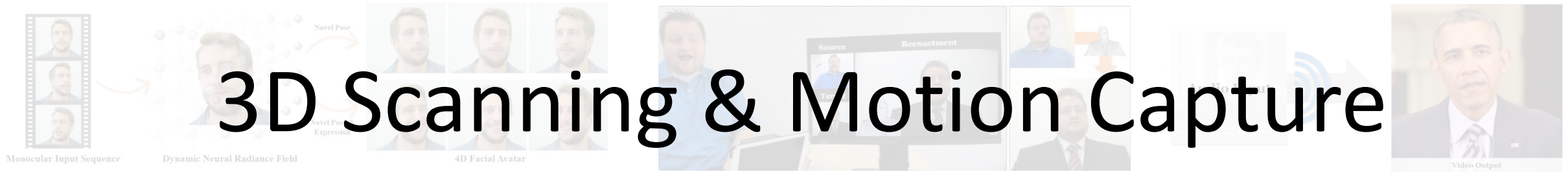


3D Scanning & Motion Capture



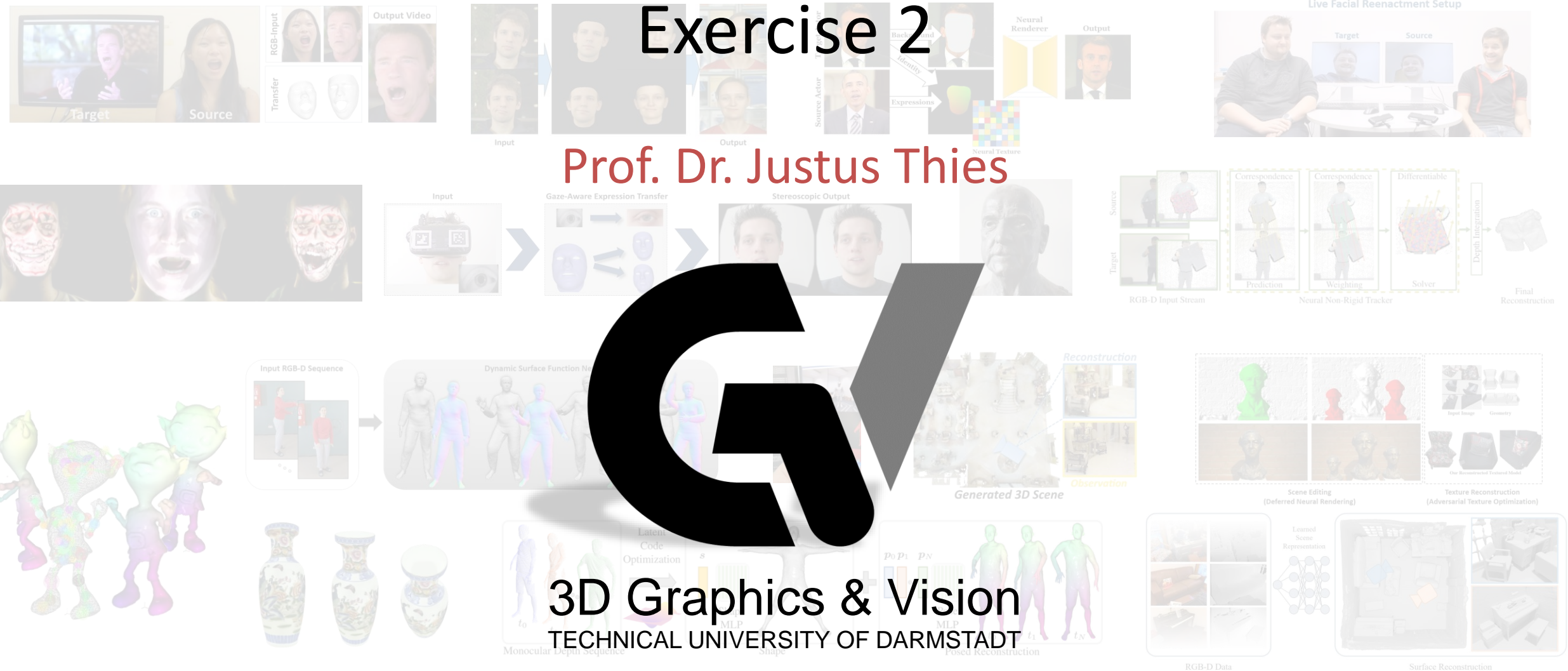
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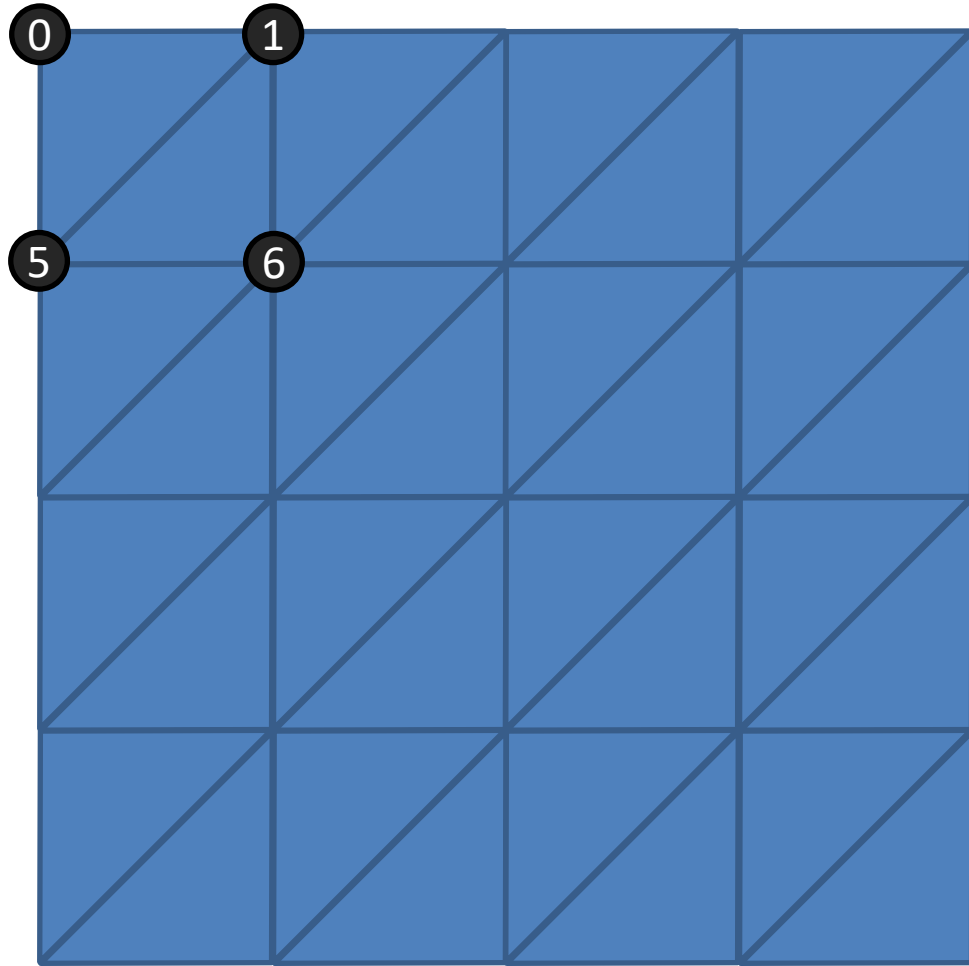
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Perspective Projection in CV

2

$$\begin{pmatrix} fov_X & 0 & c_x \\ 0 & fov_Y & c_y \\ 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ \mathbf{z} \end{pmatrix} = \begin{pmatrix} u' \\ v' \\ w' \end{pmatrix} \xrightarrow{\text{Dehomogenization}} \begin{pmatrix} u \\ v \end{pmatrix} = \begin{pmatrix} u'/w' \\ v'/w' \end{pmatrix}$$



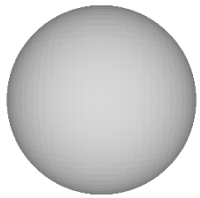
Ensure consistent
orientation of the triangles!

Example:

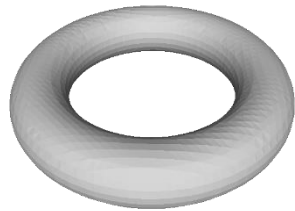
First triangle: 0-5-1

Second triangle: 5-6-1

Implicit Functions – Sphere / Torus



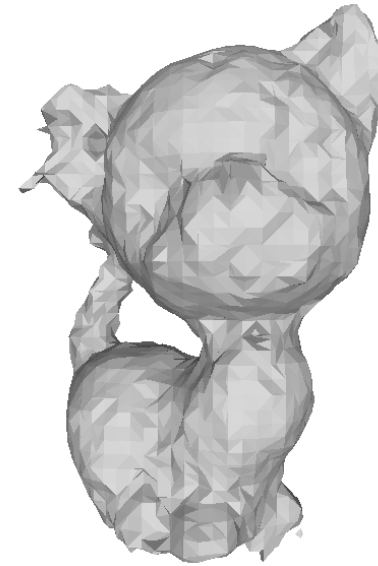
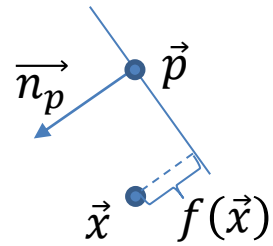
$$f(x, y, z) = x^2 + y^2 + z^2 - R^2$$



$$f(x, y, z) = (x^2 + y^2 + z^2 + R^2 - a^2)^2 - 4R^2(x^2 + y^2)$$

Implicit Functions – Hoppe

5



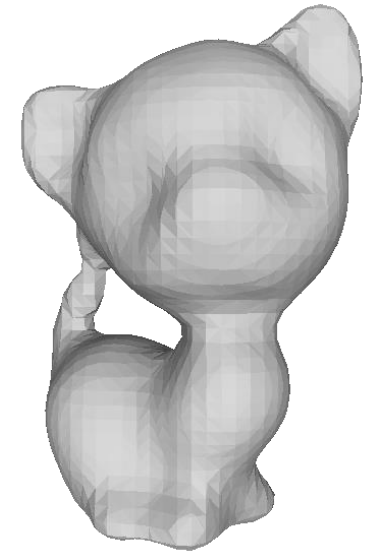
Implicit Functions – RBF

6

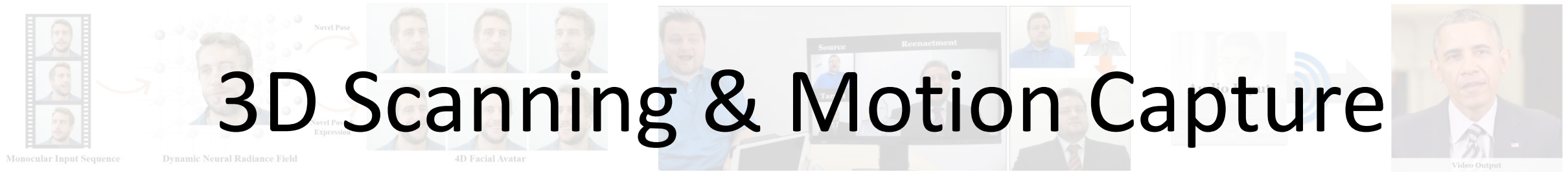
$$f(\vec{x}) = \sum_i \alpha_i \cdot \|\vec{p}_i - \vec{x}\|^3 + \vec{b} \cdot \vec{x} + d$$

$$\begin{array}{l}
 \text{on surface points} \\
 \text{off surface points}
 \end{array}
 \begin{bmatrix}
 \varphi_{1,1} & \cdots & \varphi_{1,n} & p_{1,x} & p_{1,y} & p_{1,z} & 1 \\
 \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\
 \varphi_{n,1} & \cdots & \varphi_{n,n} & p_{n,x} & p_{n,y} & p_{n,z} & 1 \\
 \varphi_{n+1,1} & \cdots & \varphi_{n+1,n} & p_{n+1,x} & p_{n+1,y} & p_{n+1,z} & 1 \\
 \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\
 \varphi_{2 \cdot n,1} & \cdots & \varphi_{2 \cdot n,n} & p_{2 \cdot n,x} & p_{2 \cdot n,y} & p_{2 \cdot n,z} & 1
 \end{bmatrix}
 \cdot \begin{bmatrix} \alpha_1 \\ \vdots \\ \alpha_n \\ b_1 \\ b_2 \\ b_3 \\ d \end{bmatrix} = \begin{bmatrix} h_1 \\ \vdots \\ h_{2 \cdot n} \end{bmatrix}$$

$A \cdot \vec{x} = \vec{b}$



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