Update On 3D Orientation Reconstruction

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January 17, 2017

Forward Model

$$g_i = \int_{\mathbb{S}^2} d\hat{\mathbf{r}}\ h_i(\hat{\mathbf{r}}) f(\hat{\mathbf{r}})$$

- $g_i \rightarrow$ is the ith intensity measurement
- $h_i(\hat{\mathbf{r}}) \rightarrow$ is the ith point response function
- $f(\hat{\mathbf{r}}) \rightarrow$ is the orientation distribution function

Integral $\rightarrow$ Matrix

$$g_i = \int_{\mathbb{S}^2} d\hat{\mathbf{r}}\ h_i(\hat{\mathbf{r}}) f(\hat{\mathbf{r}})$$

$$g_i = \mathbf{H}_i^T \mathbf{F}$$

$$\mathbf{g} = \mathbf{\Psi} \mathbf{F}$$

Discrete Inverse Transform Matrix B

$$\mathbf{f} = \mathbf{B}\mathbf{F}$$

where $\mathbf{f}$ is a discrete approximation to the true distribution $f(\hat{\mathbf{r}})$. $\mathbf{f}$ is an $R \times 1$ vector where R is the number of points on the sphere (like pixels on the sphere). I'm using $R = 250$ for now.

Now the discretized forward model is

$$\mathbf{g} = \mathbf{\Psi}\mathbf{B}^{+}\mathbf{f}$$

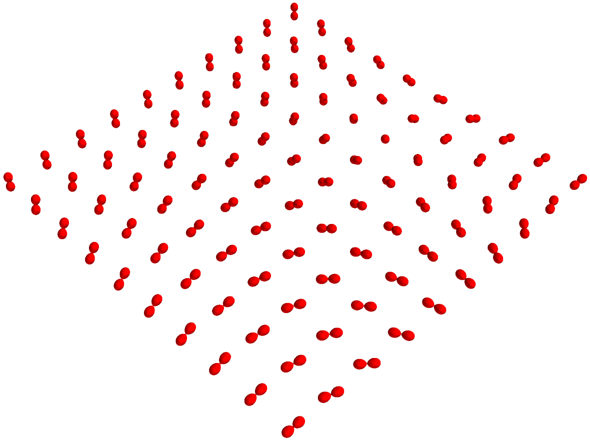
Reconstruction Problem

$$\begin{aligned} \mathbf{F}^* = \underset{\mathbf{F}}{\operatorname{argmin}} & \quad ||\mathbf{g} - \mathbf{\Psi}\mathbf{F}||_2^2 \\ \text{subject to} & \quad \mathbf{B}\mathbf{F} \succeq 0 \end{aligned}$$

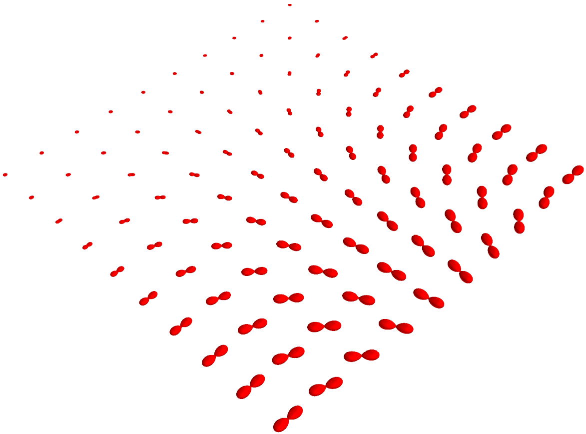
Then plot:

$$\mathbf{f}^* = \mathbf{B}\mathbf{F}^*$$

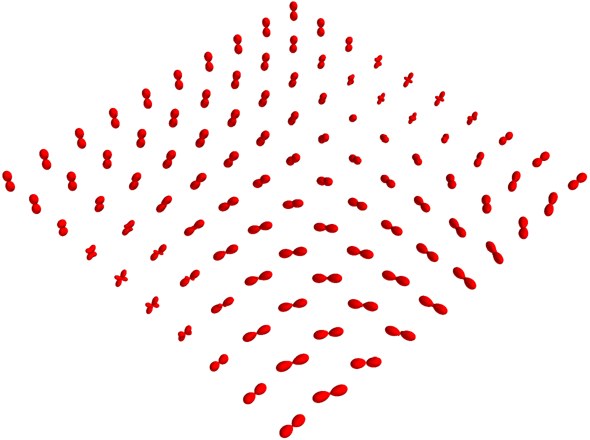
Phantom



Reconstructed with data from single-view epi-illumination NA = 0.7



Reconstructed with data from diSPIM



Reconstructed with priors

$$\begin{aligned} \mathbf{f}^* = \ & \underset{\mathbf{f}}{\operatorname{argmin}} && ||\mathbf{g} - \mathbf{\Psi}\mathbf{B}^+\mathbf{f}||_2^2 \\ & \text{subject to} && \mathbf{f} \in \text{prior set} \end{aligned}$$