EECS 16A ## 12.3 LECTURE 26

Continuing from last time:

How much of $\vec{r}$ is explained by $\vec{s}_2$? $\hat{\alpha}_2 = \frac{\langle \vec{r}, \vec{s}_2 \rangle}{\|\vec{s}_2\|^2}$

$\vec{e} = \vec{r} - \hat{\alpha}_2 \vec{s}_2$ "error | residual"

Consider $\langle \vec{e}, \vec{s}_1 \rangle$ $\langle \vec{e}, \vec{s}_{10000} \rangle$

$$\langle \vec{e}, \vec{s}_2 \rangle = \langle \vec{r} - \hat{\alpha}_2 \vec{s}_2, \vec{s}_2 \rangle = \langle \vec{r}, \vec{s}_2 \rangle - \hat{\alpha}_2 \langle \vec{s}_2, \vec{s}_2 \rangle$$
$$= \langle \vec{r}, \vec{s}_2 \rangle - \frac{\langle \vec{r}, \vec{s}_2 \rangle}{\|\vec{s}_2\|^2} \cdot \|\vec{s}_2\|^2 = \boxed{0}$$

Say $\vec{s}_4$ is the next max $\vec{r} = \alpha_2 \vec{s}_2 + \alpha_4 \vec{s}_4 +$

Project $\vec{r}$ onto col $\{\vec{s}_2, \vec{s}_4\}$ $S = [\vec{s}_2 \; \vec{s}_4]$

$S \rightarrow S \begin{bmatrix} \alpha_2 \\ \alpha_4 \end{bmatrix} \approx \vec{r}$ least squares!

$S \hat{\vec{\alpha}} = \vec{r} \longrightarrow \hat{\vec{\alpha}} = (S^T S)^{-1} \cdot S^T \vec{r}$

When do you stop?

This is a design decision. Depending on application:

- you may know sparsity level (how many devices)
- you may know the noise (stop when error $\approx$ noise)