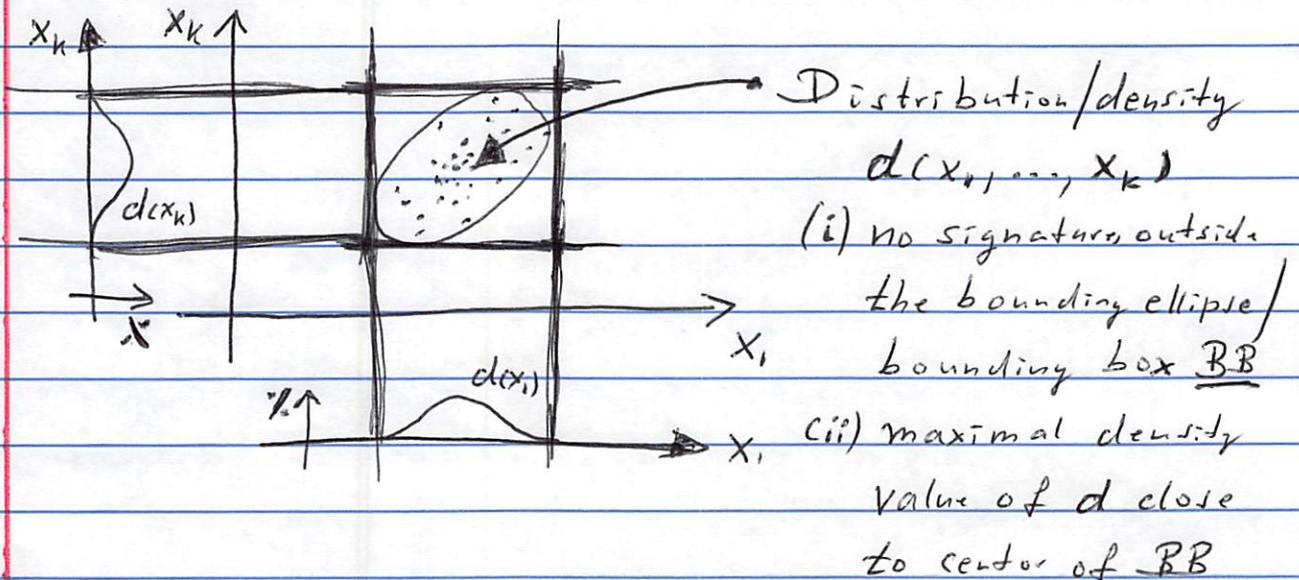


MORE ON SIGNATURES & CLASSIFICATION

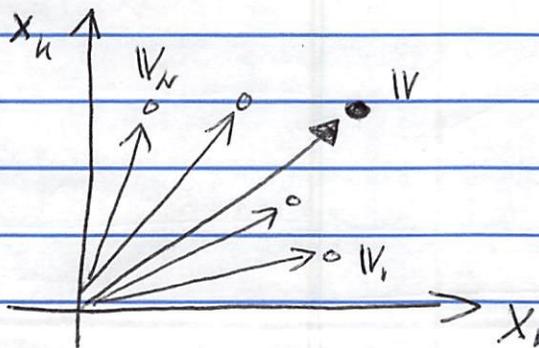
- 1) "Proto-type signatures of a specific material class define a DISTRIBUTION in a k-dim. signature space."



⇒ Can define a measure to estimate the distance between any "point" $(\bar{x}_1, \dots, \bar{x}_k)$ and the general distribution function $d(x_1, \dots, x_k)$

OR: Can define and compute a probability value for the likelihood that a point $(\bar{x}_1, \dots, \bar{x}_k)$ belongs to the class defined by distribution d .

2) OVER- AND UNDER DETERMINED LINEAR SYSTEMS // Least-squares Method to Approximate a given, new histogram via a linear combination of stored proto-type histograms



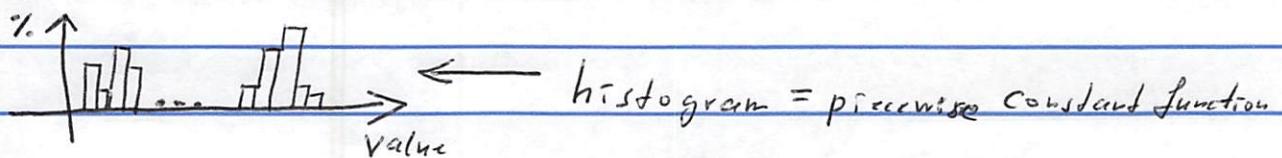
- v = new k -dim signature (vector)
- N stored proto-type vectors

$$\Rightarrow \sum_{i=1}^N c_i v_i = v$$

\Rightarrow Cases: $N < k$, $N = k$, $N > k$...

\Rightarrow Related to: Best Approximation of Functions (Histograms!)

3) BEST APPROXIMATION OF FUNCTIONS/HISTOGRAMS



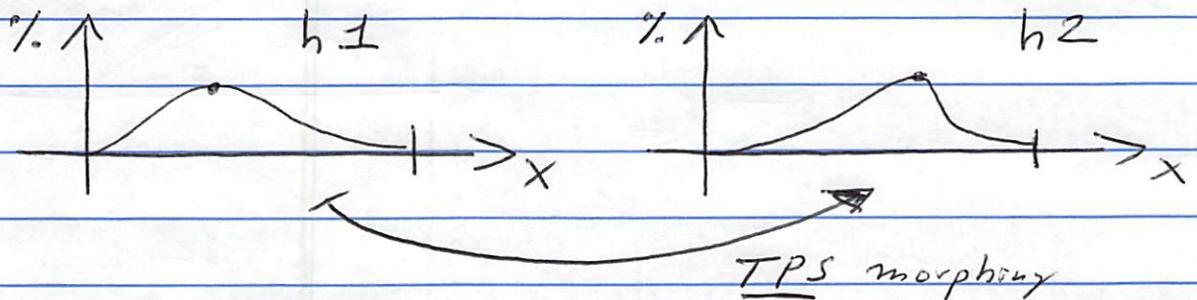
\Rightarrow Given M histograms (= basis functions) of M material classes, approximate a new, "incoming" histogram as a best-possible linear combination of M basis fcts.:

$$f \doteq \sum_{i=1}^M c_i f_i, \text{ with basis fcts. } f_i \text{ and new function } f;$$

\Rightarrow Best approximation of f : Solve system
$$\begin{pmatrix} \langle f_1, f_1 \rangle & \dots & \langle f_1, f_M \rangle \\ \vdots & & \vdots \\ \langle f_M, f_1 \rangle & \dots & \langle f_M, f_M \rangle \end{pmatrix} \begin{pmatrix} c_1 \\ \vdots \\ c_M \end{pmatrix} = \begin{pmatrix} \langle f, f_1 \rangle \\ \vdots \\ \langle f, f_M \rangle \end{pmatrix}, \text{ with } \langle f, g \rangle = \int f \cdot g \, dx$$

4) THIN PLATE SPLINES AS A MEANS TO COMPARE
SIGNATURES / HISTOGRAMS...

⇒ IDEA: Two signatures represent the same material type if the "TPS energy" required to morph/deform one signature into the other is $< \epsilon$.



⇒ Compute a TPS deformation h_1 into h_2 ; determine the associated TPS energy.

⇒ Need to define / compute (automatically) corresponding "landmark points" to define the TPS!

! ■ SUPPORTS A MORE GENERAL CONCEPT / DEFINITION OF DISTANCE BETWEEN TWO SIGNATURES / HISTOGRAMS!
(Generalizable to k -dim. signatures)