Surface Reconstruction
Level Sets
Computer Graphics

- Hoppe et al, Surface reconstruction from unorganized points, ACM Siggraph’92

- Smooth Surface Reconstruction via Natural Neighbour Interpolation of Distance Functions, ACM SoCG’00

- Alexa et al., Point Set Surfaces, IEEE Vis. 2001

- Carr et al, Reconstruction and Representation of 3D Objects With Radial Basis Functions, ACM Siggraph’01
Barycentric coordinates: examples

\[ p = rp_1 + sp_2 + tp_3 \]

\[ r = \frac{\text{area}(\triangle(pp_1p_3))}{\text{area}(\triangle(p_1p_2p_3))} \quad s = \frac{\text{area}(\triangle(pp_2p_3))}{\text{area}(\triangle(p_1p_2p_3))} \quad t = \frac{\text{area}(\triangle(pp_1p_2))}{\text{area}(\triangle(p_1p_2p_3))} \]

No simplices — \( n > p + 1 \)?
Definition. 1  
**Sibson’s coordinates:**

\[
\lambda_i = \frac{\text{area}(\text{Vor}(p, p_i))}{\text{area}(\text{Vor}(p))}
\]

Theorem. 1  
**Barycentric equality:**

\[
p = \sum_i \lambda_i p_i
\]
Reconstruction of smooth surfaces

Defs: \( h(p) = \sum_i \lambda_i(p) h_i(p), \quad \partial \hat{S} = h^{-1}(0) \)

\begin{itemize}
  \item Observation: \( h \) interpolates the points and the \( h_i \)
  \item Observation: Guarantees…
\end{itemize}
Detecting the bipolar facets

**Def.** A Delaunay triangle is called bipolar if

\[ IF(cc_1) \ast IF(cc_2) \leq 0 \]
Implicit surface
Restricted Delaunay Triangulation
Implicit versus Modified Implicit

- Limitations
  - Natural weights / coordinates
  - Merits of the 0-level set?

- Code integrated to CATIA-v5 (March 2001)