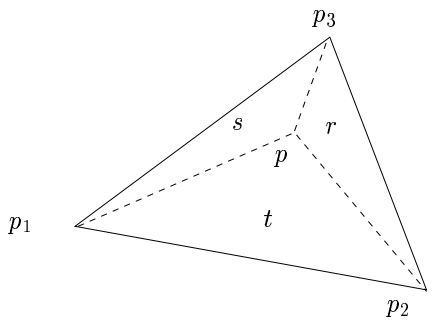
Surface Reconstruction
Level Sets
Computer Graphics

- 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

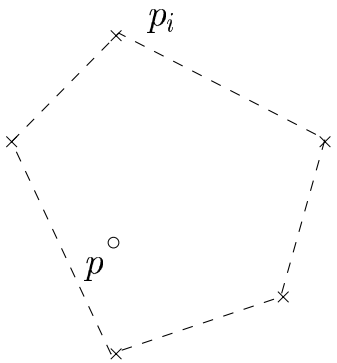
Barycentric coordinates: exples

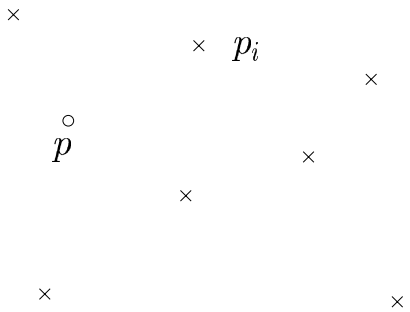


$$p = rp_1 + sp_2 + tp_3$$

$$r = \frac{area(\triangle(pp_1p_3))}{area(\triangle(p_1p_2p_3))} s = \frac{area(\triangle(pp_2p_3))}{area(\triangle(p_1p_2p_3))} t = \frac{area(\triangle(pp_1p_2))}{area(\triangle(p_1p_2p_3))}$$

No simplices —$n > p+1$?



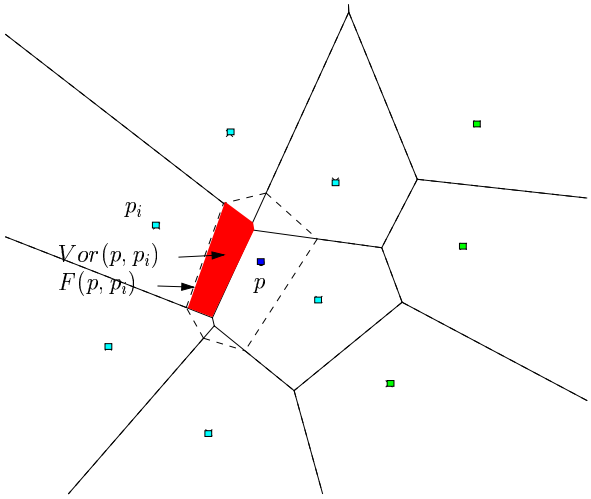


Natural coordinates:

Sibson's coordinates

Definition. 1 *Sibson's coordinates:*

$$\lambda_i = \frac{area(Vor(p, p_i))}{area(Vor(p))}$$

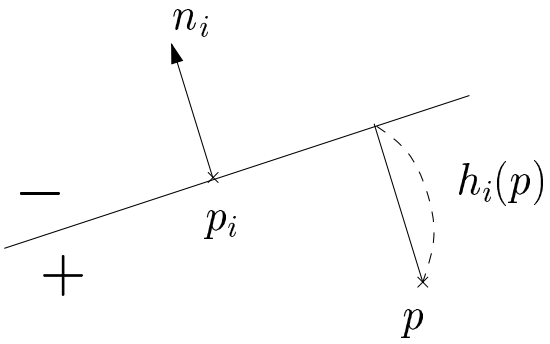


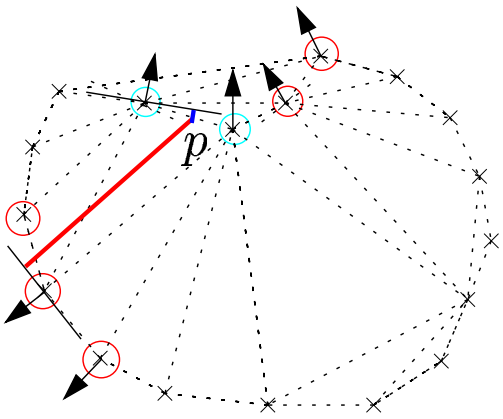
Theorem. 1 *Barycentric equality:*

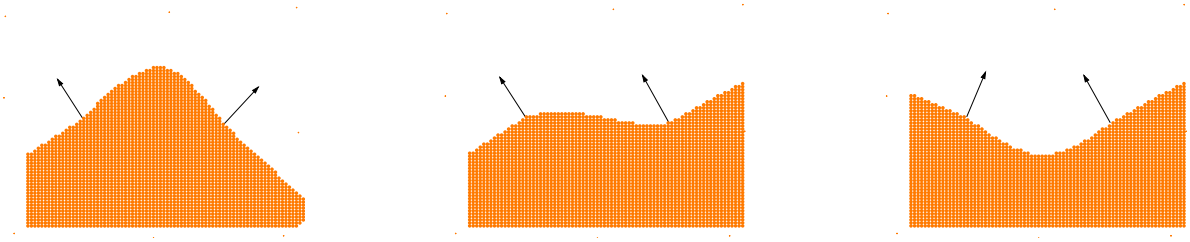
$$p = \sum_i \lambda_i p_i$$

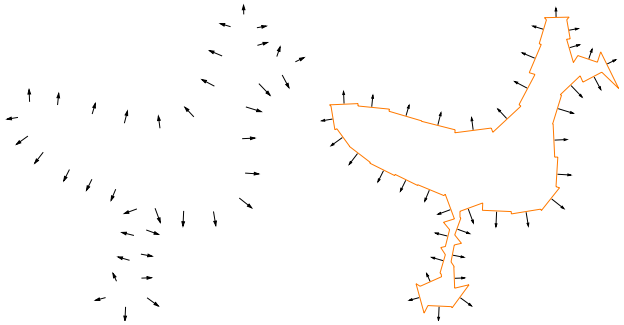
Reconstruction of smooth surfaces

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





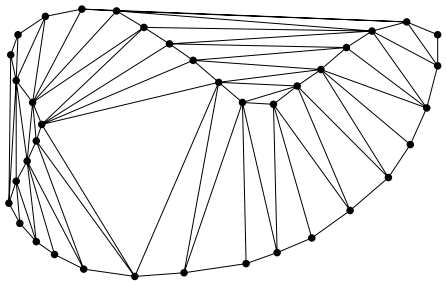


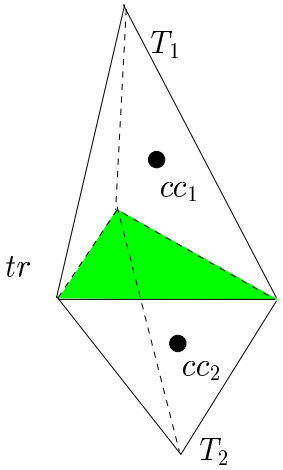


◁ Observation: h interpolates the points and the h_i

◁ Observation: Guarantees. . .

Detecting the bipolar facets



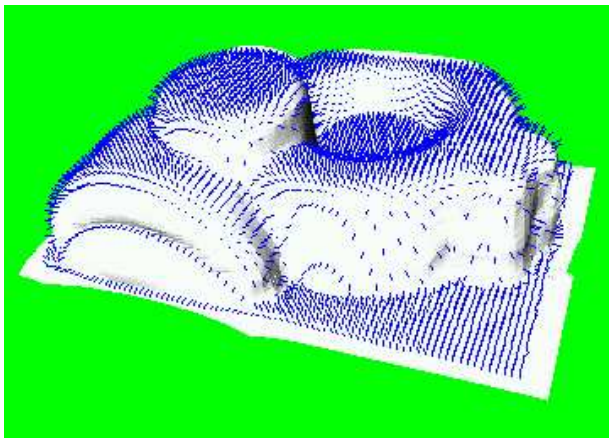


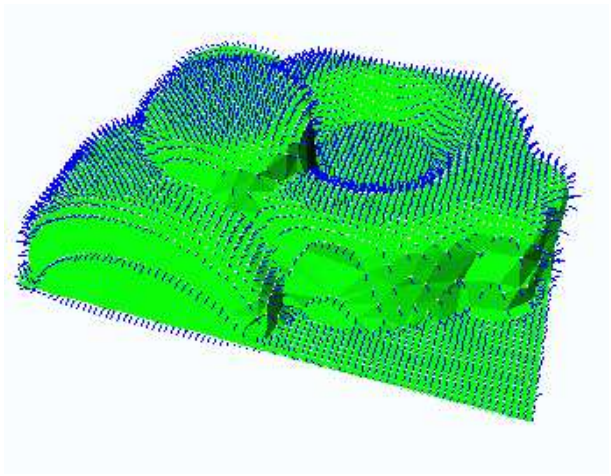
Def. A Delaunay triangle is called bipolar if

$$IF(cc_1) * IF(cc_2) \leq 0$$

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)