Multiresolution Editing of Pasted Surfaces

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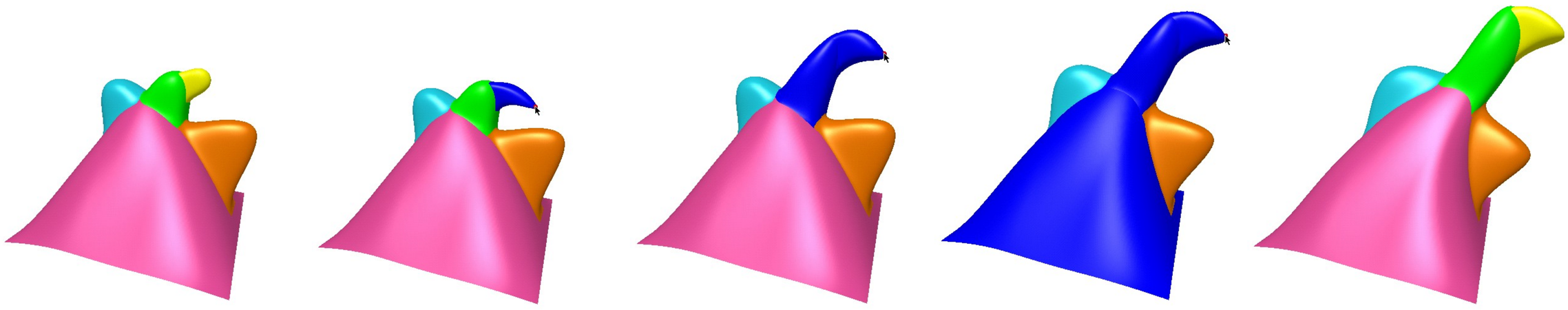
Special thanks to Richard Bartels and Blair Conrad



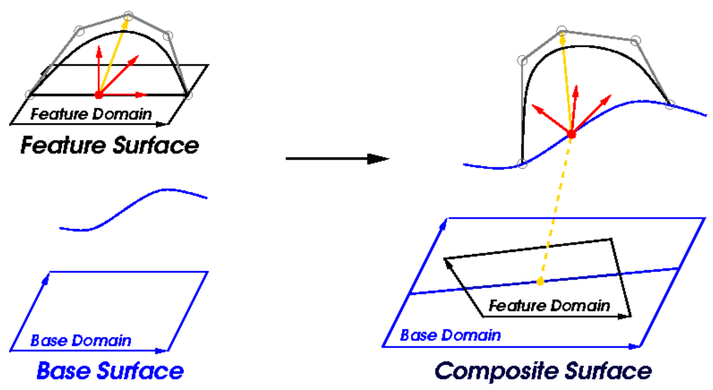
Background

1. Hierarchical Modelling

- model smooth surfaces with local detail
- examples: car door, face
- allows multiresolution editing

2. Surface Pasting

- represent each feature control point as a displacement vector
- for each feature control point
  - find corresponding feature domain point
  - map into base domain
  - evaluate base at mapped point to get coordinate frame
  - express displacement vector relative to coordinate frame

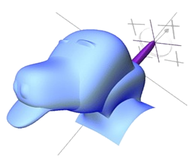


3. Features of Surface Pasting

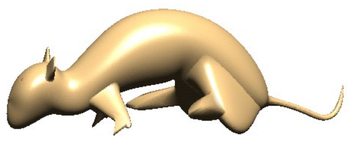
- developed by Bartels & Forsey

\+ computationally inexpensive — only feature control points are mapped
\+ pasted feature may have non-rectangular domain
\+ flexible modelling paradigm — features may be translated, rotated and scaled
\+ library of features to apply to any base
\+ hierarchical pasting (hierarchical modelling)
– only approximates displacement maps — no continuity between feature and base
but the discontinuity can be made as small as desired

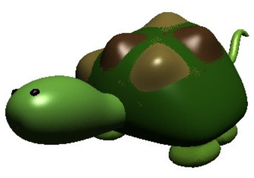
4. Examples of Pasted Surfaces



dog model by Leith Kin Yip Chan



model of Sprite the Ferret by Selina Siu



turtle model by Selina Siu

dog model by Clara Tsang

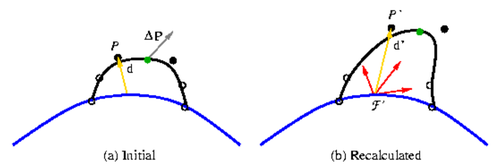
Direct Manipulation

5. Tensor Product Surfaces

- based on Bartels & Beatty's curve manipulation technique
- suppose we want to move a point $S(u,v) = \sum_i \sum_j B_{i,j}(u,v) P_{i,j}$ by ΔP
- move 2x2 block of control points with most influence over $S(u,v)$ call them $P_{a,b}, P_{a+1,b}, P_{a,b+1}, P_{a+1,b+1}$
- find weights $w_{i,j}$ proportional to $B_{i,j}$'s contribution to $S(u,v)$ $w_{i,j} := \frac{B_{i,j}(u,v)}{\sum_{k=a}^{a+1} \sum_{l=b}^{b+1} B_{k,l}(u,v)}$
- set $P'_{i,j} = P_{i,j} + w_{i,j} \Delta P$

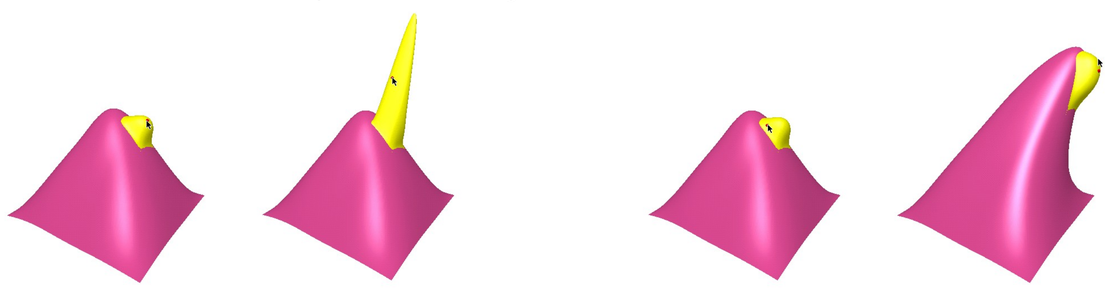
6. Pasted Surfaces

- update control points using method described above
- recalculate displacement vectors for each control point
- if feature is translated or underlying surface changes, the changes made by direct manipulation will be preserved



7. Manipulating Near Feature Boundary

- need to fix the boundary and cross boundary derivatives of pasted surfaces
- ensure that 2 outermost rings of surface's control points do not move
- what if user tries to manipulate in this region?



a) find alternative block of control points
→introduces distortions

b) push all the work to a lower surface if possible
→picked point will not follow mouse cursor

8. Hierarchical Direct Manipulation

- allow user to choose which surface in pasting hierarchy will do most work
- apply ΔP to that surface
- corresponding point on next higher surface will not have moved by ΔP
- for each higher surface in turn,
  - find correction factor — difference between actual movement and ΔP
  - apply correction factor to the surface
- give user more control over granularity of change