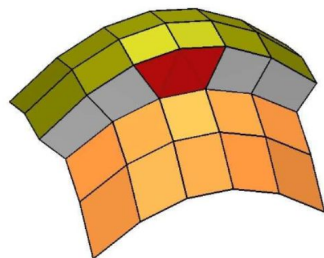
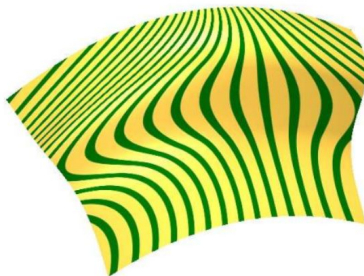


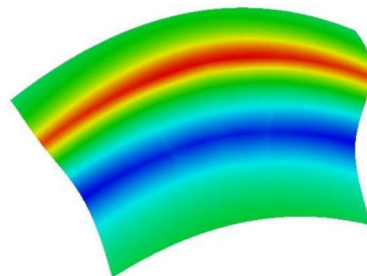
T-junctions in spline surfaces



(a) \dot{T} -net



(b) highlight lines



(c) mean curvature

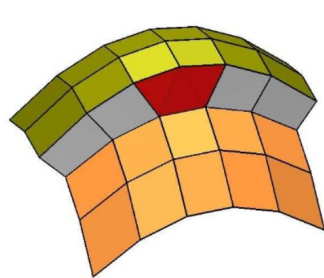
Kęstutis Karčiauskas, Daniele Panozzo, Jörg Peters

Funded by NSF-CCF and DARPA TRADES

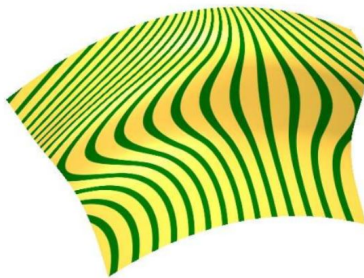
Siggraph 2018, Vancouver



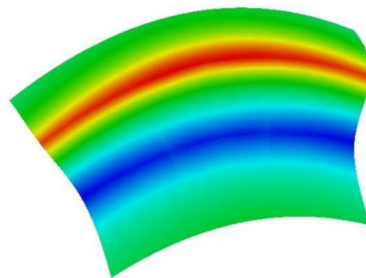
T-junctions in spline surfaces



(a) \dot{T} -net



(b) highlight lines



(c) mean curvature

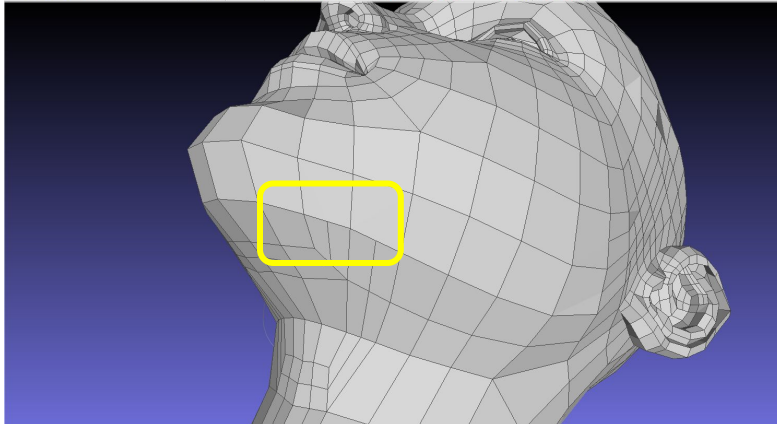
Kęstutis Karčiauskas, Daniele Panozzo, Jörg Peters

Funded by NSF-CCF and DARPA TRADES

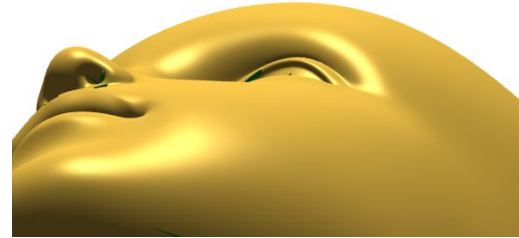
Siggraph 2018, Vancouver

T-junctions = where features start or terminate

T-junctions in Spline Surfaces

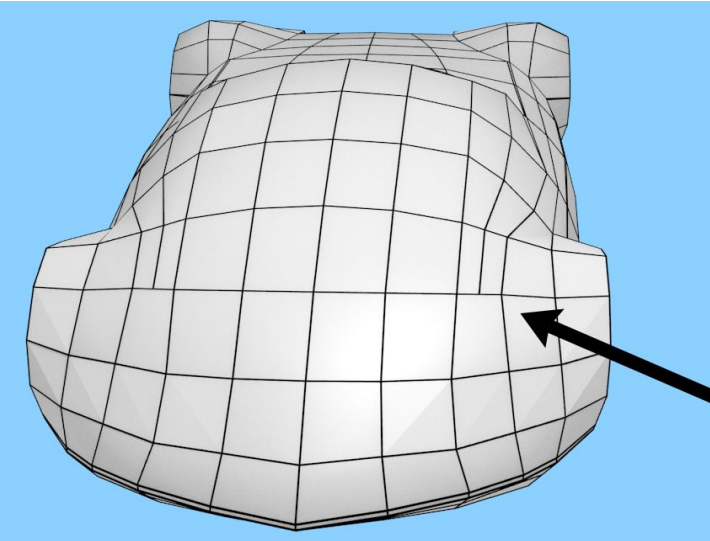


“Make irregularities (T-junctions) disappear”

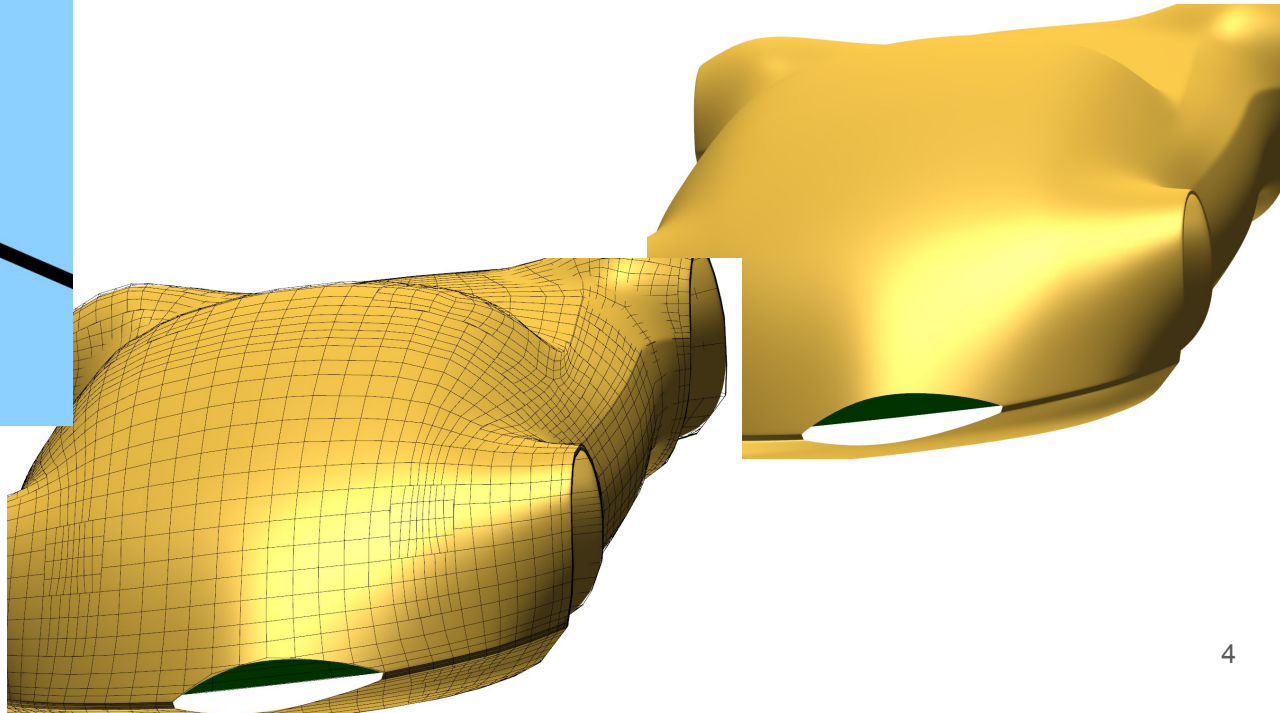


T-junctions = where features start or terminate

T-junctions in Spline Surfaces

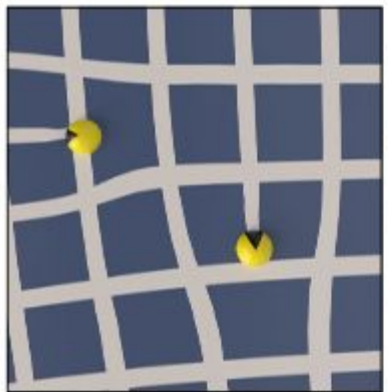


“Make T-junction disappear”



T-junctions = where features start or terminate

➤ Automatic quad meshing



strict quad-meshing [Bommes et al. 2012; Vaxman et al. 2016] complex and global

→ **T-meshes** [Li et al. 2006; Lai et al. 2008, Alliez et al. 2003; Marinov Kobbelt 2004, Myles et al. 2010; 2014a; Pietroni et. 2016, Zdravec et al. 2010; PengWonka 2013, Ray et al. 2006; Jakob et al. 2015] **Instant field-aligned meshes**

T-junctions = where features start or terminate

- Automatic quad meshing
- Merge separately-developed spline surfaces



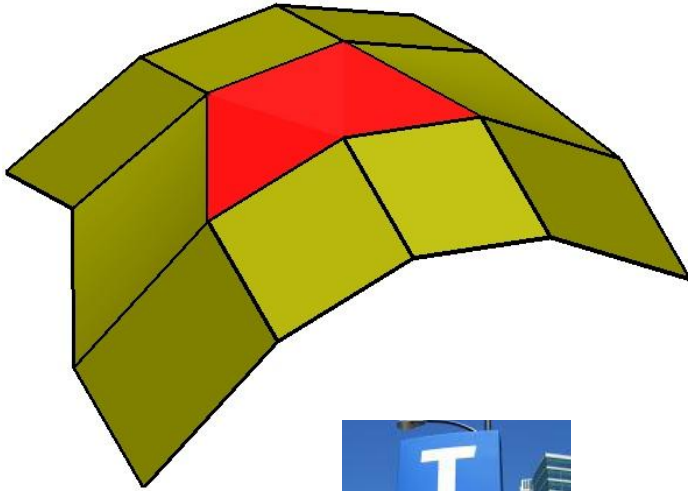
- Configurations
- Alternatives
 - T-junctions → T-splines ?
 - T-junctions → Catmull-Clark subdivision ?
 - T-junctions → Geometric continuity ?
- Construction
- T- G-splines = merging meshes T1 T2 T3

The extremely short
(use it) presentation

T-G-spline surface construction: **executive version**

T-junctions in Spline Surfaces

Turn into smooth surface



Highlight lines

T-junctions in Spline Surfaces



Farin

(a) reflection lines

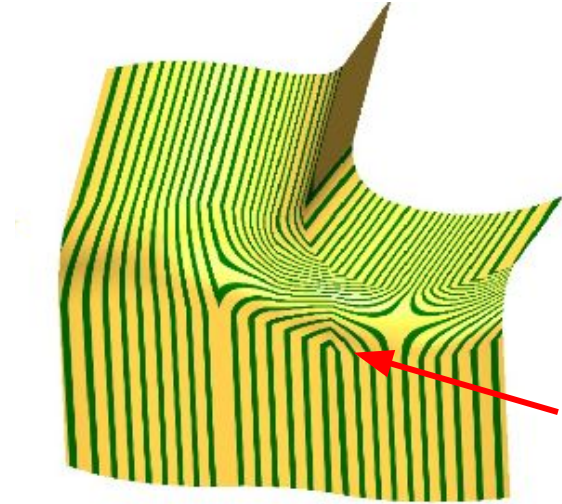
uniform, parallel = good (unless feature)

Highlight lines

T-junctions in Spline Surfaces



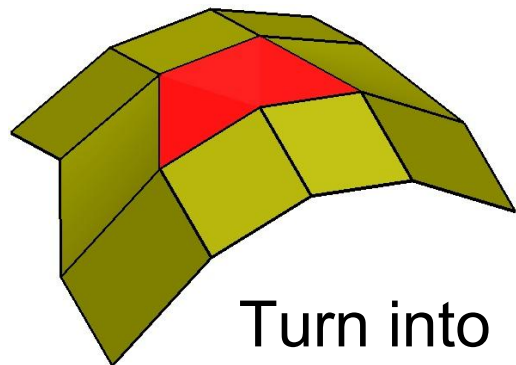
reflection lines



highlight lines

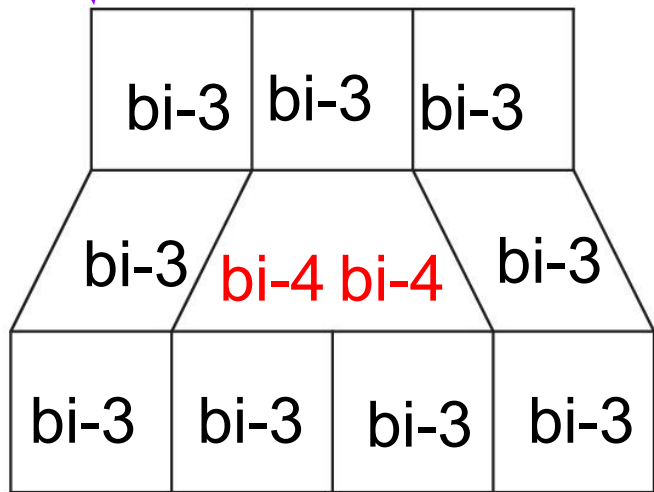
T-G-spline surface construction: executive version

T-junctions in Spline Surfaces



Turn into
smooth
surface

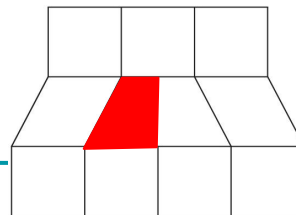
Outer can be irregular



bi-3 = bi-cubic =
polynomial patch of
coordinate degree 4

assume isolated T-junction

T-G-spline bi-4 = 5 x 5 Bezier



coefficients

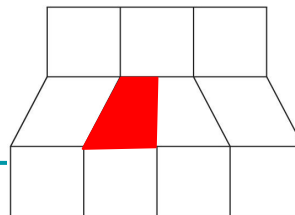
T-junctions in Spline Surfaces

$$\begin{array}{ccccc}
 \begin{bmatrix} 4 & 16 & 16 & 4 & 0 & 0 \\ 4 & 16 & 16 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{5}{3} & 16 & \frac{11}{2} & 0 \\ \frac{5}{3} & 16 & \frac{11}{2} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{3}{3} & 15 & \frac{15}{2} & 0 \\ \frac{3}{3} & 15 & \frac{15}{2} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{7}{8} & \frac{107}{8} & \frac{77}{8} & \frac{1}{8} \\ \frac{7}{8} & \frac{107}{8} & \frac{77}{8} & \frac{1}{8} \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{2} & \frac{33}{2} & \frac{33}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{33}{2} & \frac{33}{2} & \frac{1}{2} \\ 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 1 & 4 & 1 & 0 \\ 7 & 16 & 16 & 7 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{4} & 4 & \frac{7}{4} & 0 \\ \frac{1}{4} & 16 & \frac{7}{4} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{8} & \frac{11}{4} & \frac{11}{4} & 0 \\ \frac{1}{8} & \frac{11}{4} & \frac{11}{4} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{2} & \frac{23}{2} & \frac{23}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{23}{2} & \frac{23}{2} & \frac{1}{2} \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{8} & \frac{23}{8} & \frac{23}{8} & \frac{1}{8} \\ \frac{1}{8} & \frac{23}{8} & \frac{23}{8} & \frac{1}{8} \\ 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 \\ 12 & 12 & 48 & 12 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 6 & 48 & 18 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} -\frac{1}{8} & -\frac{1}{4} & \frac{1}{2} & 0 \\ \frac{1}{8} & \frac{1}{4} & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} -\frac{1}{16} & -\frac{5}{16} & \frac{5}{16} & \frac{1}{16} \\ \frac{1}{16} & \frac{5}{16} & \frac{5}{16} & \frac{1}{16} \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ \frac{1}{4} & 14 & \frac{87}{4} & \frac{1}{4} \\ 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 \\ 16 & 64 & 28 & 16 \\ 1 & 4 & 1 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ \frac{11}{2} & 64 & \frac{33}{2} & 0 \\ \frac{11}{2} & 4 & \frac{33}{2} & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 52 & 44 & 0 \\ 0 & 4 & 2 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & \frac{52}{2} & 64 & \frac{5}{2} \\ 0 & \frac{17}{2} & 4 & \frac{5}{2} \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 16 & 64 & 16 \\ 0 & 1 & 4 & 1 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 \\ 16 & 64 & 16 & 0 \\ 4 & 16 & 4 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 4 & 16 & 28 & 0 \\ 1 & 16 & 7 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 14 & 8 & 1 \\ 0 & 12 & 12 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 2 & \frac{23}{2} & \frac{17}{2} & 2 \\ 0 & 28 & 64 & 16 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 16 & 64 & 16 \\ 0 & 4 & 16 & 4 \end{bmatrix}
 \end{array}$$

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Short explicit formulas
(stencils)

T-G-spline bi-4 = 5x5 coefficient



stencils

T-junctions in Spline Surfaces

$\begin{bmatrix} 4 & 16 & 16 & 4 & 0 & 0 \\ 4 & 16 & 64 & 16 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{5}{3} & 16 & \frac{11}{2} & 0 \\ \frac{2}{10} & 64 & \frac{11}{22} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{3}{2} & 15 & \frac{15}{2} & 0 \\ 6 & 60 & 30 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{7}{8} & \frac{107}{8} & \frac{77}{8} & \frac{1}{8} \\ \frac{7}{2} & \frac{107}{2} & \frac{77}{2} & \frac{1}{2} \\ 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{1}{2} & \frac{33}{4} & \frac{33}{4} & \frac{1}{4} \\ 2 & \frac{33}{2} & \frac{33}{2} & \frac{1}{2} \\ 0 & 0 & 0 & 0 \end{bmatrix}$																
$\begin{bmatrix} 1 & 4 & 1 & 0 \\ 7 & 16 & 64 & 16 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{1}{2} & 4 & \frac{7}{2} & 0 \\ \frac{17}{64} & 64 & \frac{17}{10} & 0 \\ 4 & 28 & 10 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{1}{8} & \frac{33}{4} & \frac{33}{4} & 0 \\ 5 & 58 & 33 & 0 \\ \frac{67}{32} & \frac{85}{16} & \frac{267}{16} & \frac{2}{4} & \frac{-2}{32} & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{1}{2} & \frac{33}{4} & \frac{33}{4} & \frac{1}{4} \\ \frac{7}{2} & \frac{107}{2} & \frac{77}{2} & \frac{1}{2} \\ 1 & 15 & \frac{361}{8} & 6 & \frac{-1}{8} & 0 \end{bmatrix}$	$\begin{bmatrix} \frac{1}{8} & \frac{33}{8} & \frac{33}{8} & \frac{1}{8} \\ 2 & \frac{33}{4} & \frac{33}{4} & \frac{1}{2} \\ \frac{7}{16} & \frac{21}{8} & \frac{161}{8} & \frac{33}{4} & \frac{7}{16} & 0 \end{bmatrix}$																
$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 12 & 48 & 12 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 6 & 48 & 18 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	<div>$\begin{bmatrix} -\frac{1}{8} & -\frac{1}{4} & \frac{1}{2} & 0 \\ 7 & \frac{115}{8} & 31 & 4 & \frac{1}{8} \\ 0 & 0 & -2 & 0 & 0 \end{bmatrix}$</div>	<div>$\begin{bmatrix} -\frac{1}{8} & -\frac{1}{4} & \frac{1}{2} & 0 \\ 9 & \frac{47}{8} & 87 & 9 & -1 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$</div>	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 14 & 32 & 14 & 1 \end{bmatrix}$																
$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 16 & 64 & 28 & 7 & 0 & 0 \\ 1 & 4 & 1 & 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 17 & 28 & 25 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 25 & 14 & 0 & 0 & 0 \\ 0 & 4 & 2 & 0 & 0 & 0 \end{bmatrix}$	<div><table><tr><td>-1</td><td>-2</td><td>3</td><td>0</td></tr><tr><td>19</td><td>258</td><td>150</td><td>5</td></tr><tr><td>7</td><td>232</td><td>186</td><td>8</td></tr><tr><td>0</td><td>4</td><td>-4</td><td>0</td></tr></table></div>		-1	-2	3	0	19	258	150	5	7	232	186	8	0	4	-4	0
-1	-2	3	0																	
19	258	150	5																	
7	232	186	8																	
0	4	-4	0																	
$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 16 & 64 & 16 & 4 & 0 & 0 \\ 4 & 16 & 4 & 0 & 0 & 0 \end{bmatrix}$		$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 14 & 8 & 1 \\ 0 & 12 & 12 & 0 & 0 & 0 \end{bmatrix}$																		

F# Code:



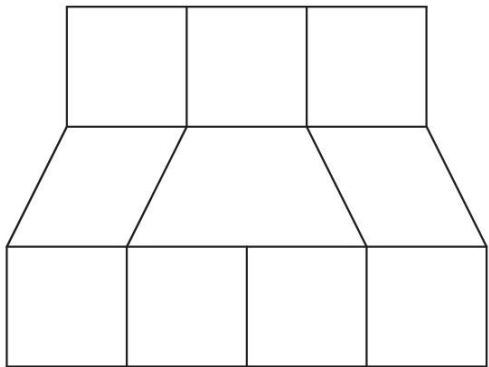
Short explicit formulas /864

Long version: Overview

- **Some T-configurations**
- Alternatives
 - T-junctions → T-splines ?
 - T-junctions → Catmull-Clark subdivision ?
 - T-junctions → Geometric continuity ?
- Construction
- T-G-splines = merging meshes T1 T2 T3

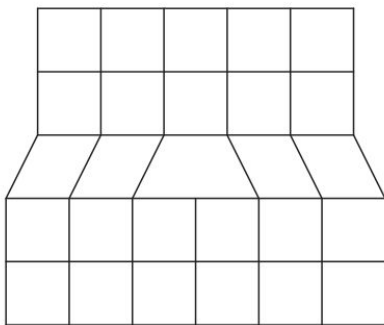
T-junctions (Extended) Configurations T1 T2 T3

T-junctions in Spline Surfaces

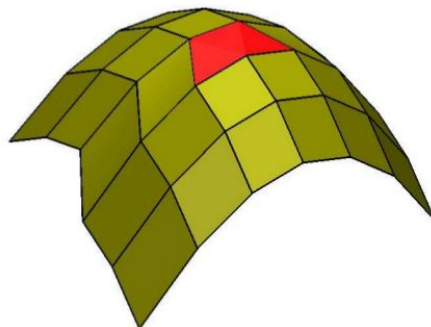


Extended to regular
bi-3 neighborhood

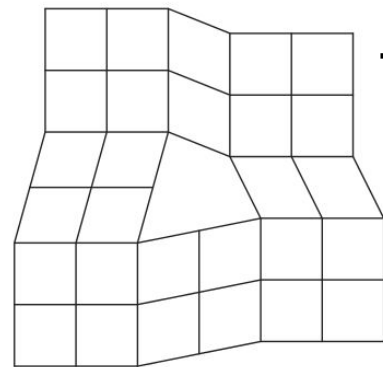
T1



(a) \dot{T} -net layout

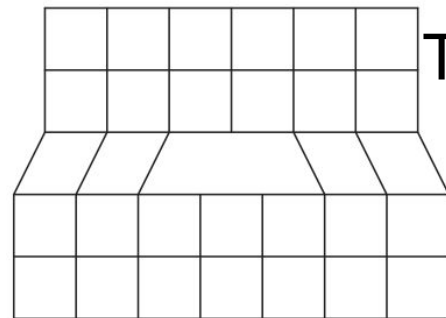


(b) convex \dot{T} -net



(a) \ddot{T} -net

T2



(b) \ddot{T} -net

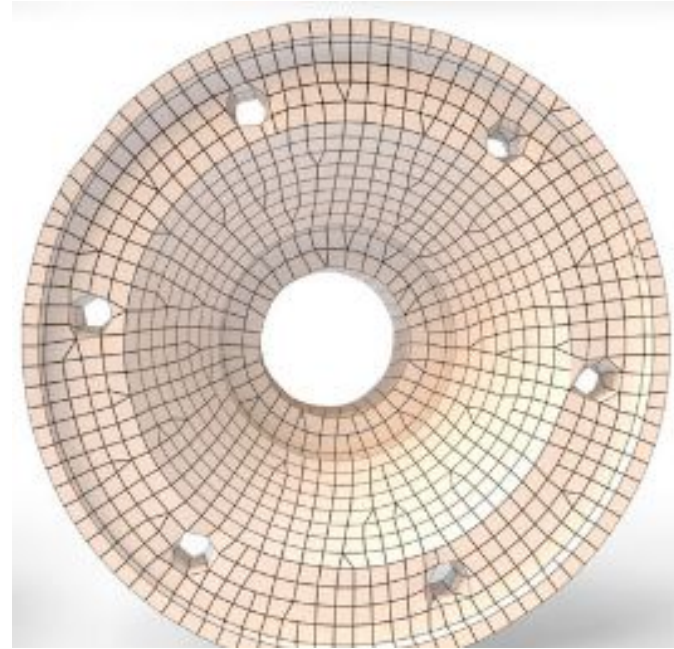
T3

Configurations: Meshing & Surface quality

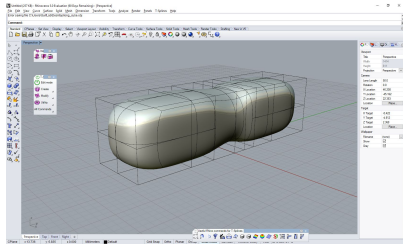
T-junctions in Spline Surfaces

**Trade off between
meshing work and
surface construction:**

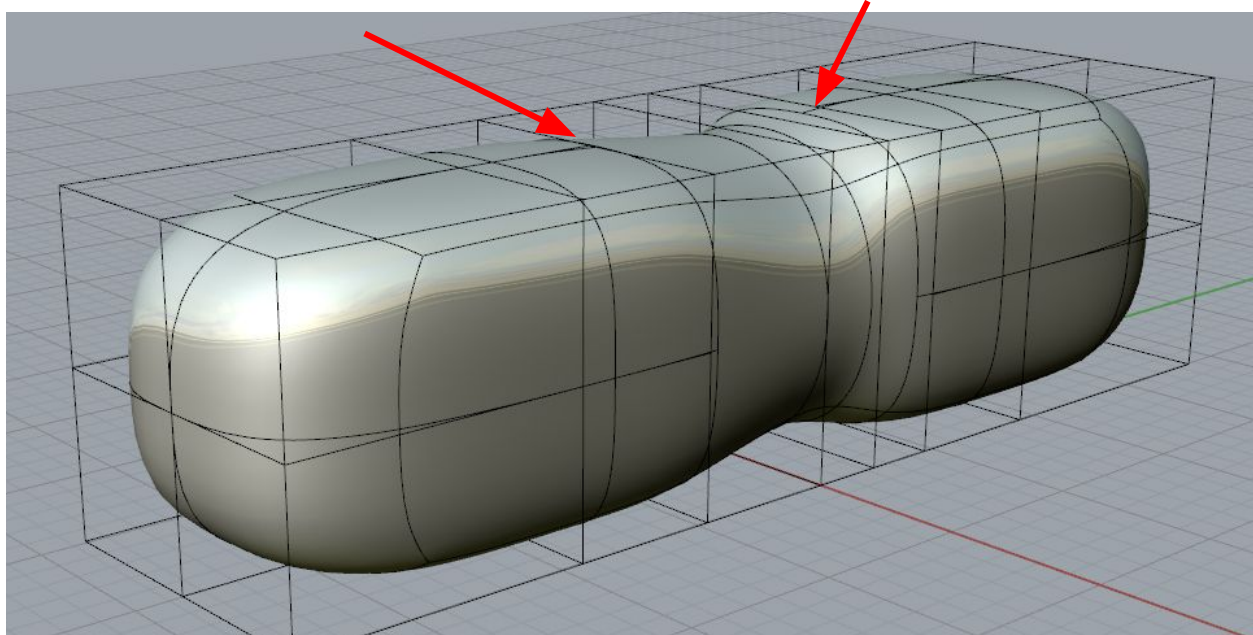
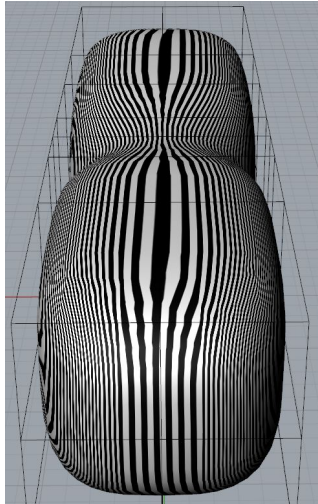
Bad mesh → bad surface



T-junctions -- use with care !



bad design or intended?

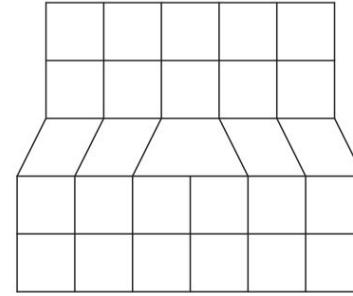
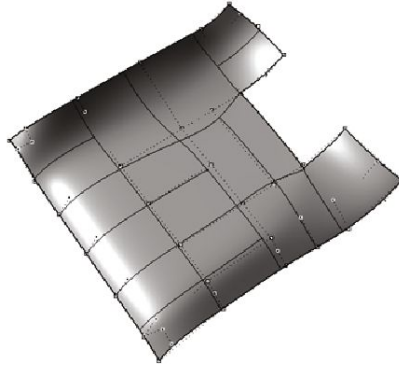
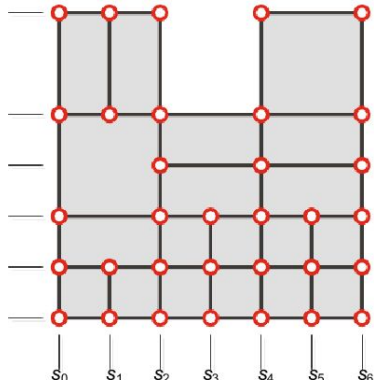


Long version: Overview

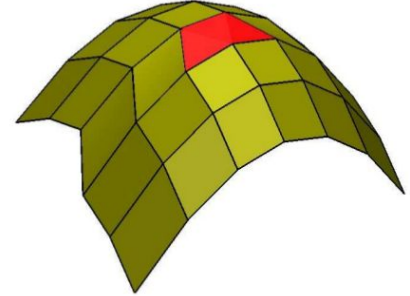
- Some T-configurations
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T-junctions \rightarrow T-splines ?

T-junctions in Spline Surfaces



(a) \dot{T} -net layout



(b) convex \dot{T} -net

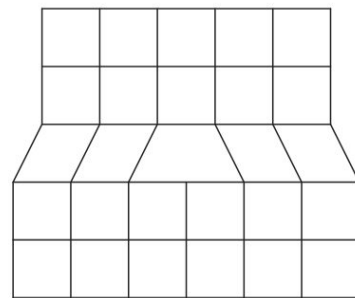
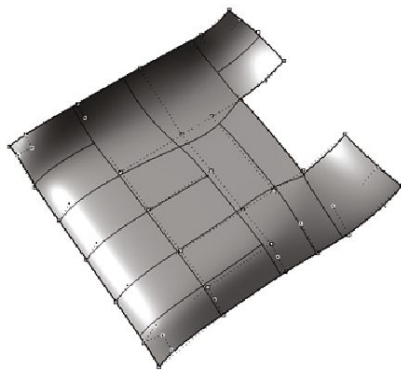
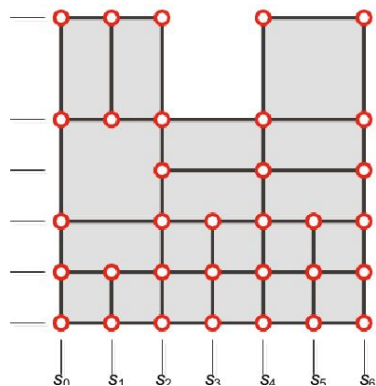
T Sederberg, J Zheng, A Bakinov, A. Nasri 03

global

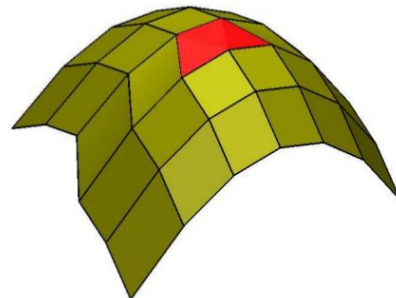
local

T-junctions \rightarrow T-splines (hierarchical splines)?

T-junctions in Spline Surfaces



(a) \dot{T} -net layout



(b) convex \dot{T} -net

“cast”
global



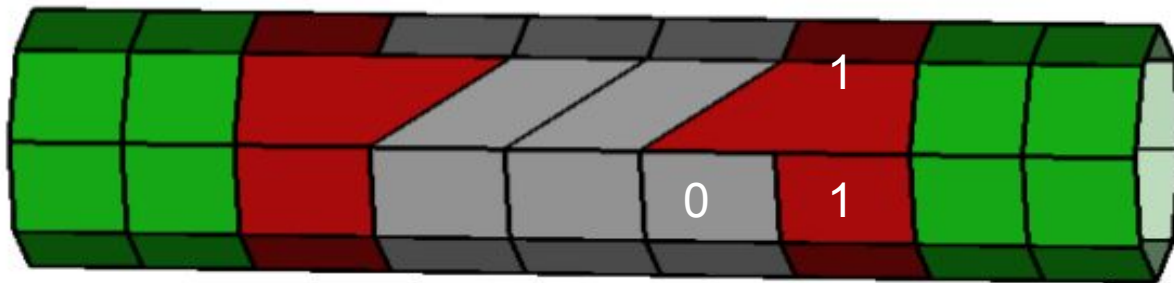
“band-aid”
local



where T-splines fail

T-splines: “Rule 1”

sum of knot intervals on opposing edges of any face must be equal



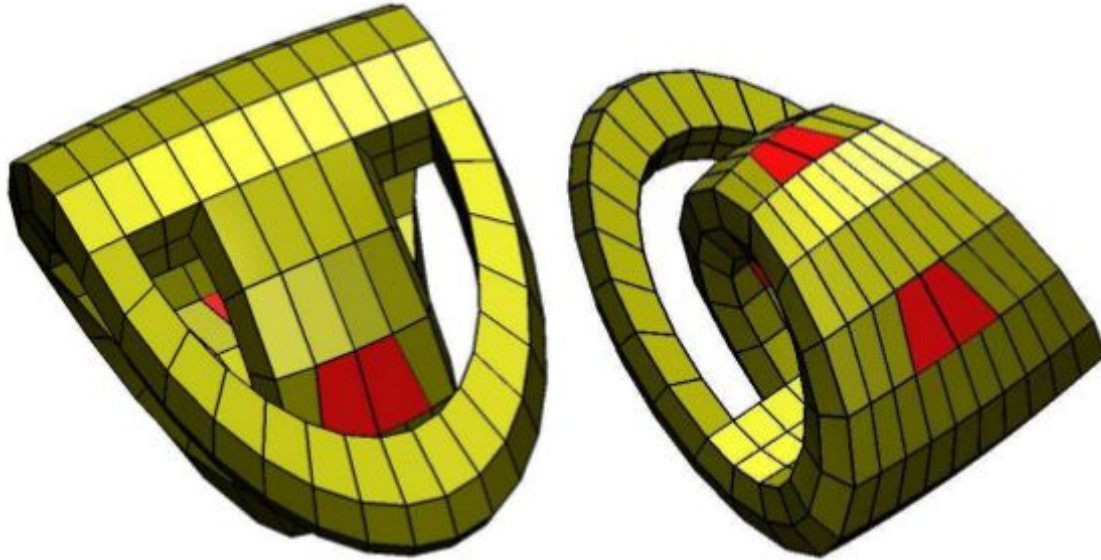
Dagstuhl 2016

- horizontal knot intervals of the grey helical strip have 0 knot intervals
- no smooth T-spline parameterization!

Denis Zorin et al: two different knots sets on either side of an edge

where T-splines (hierarchical splines) fail

T-junctions in Spline Surfaces



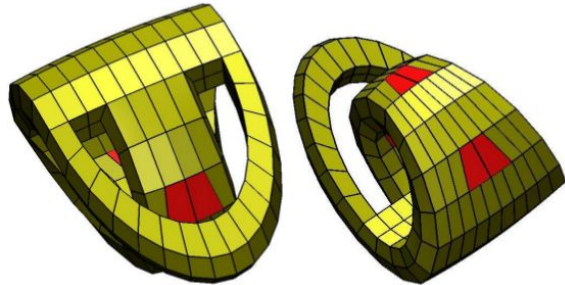
no smooth T-spline parameterization!

When (not) to use Hierarchical Splines

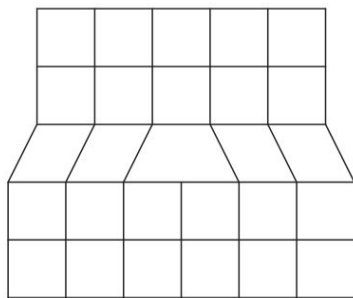
Hierarchical splines

[Kraft1998;Seder2003;Giannelli12;Dokken13,Kang15]

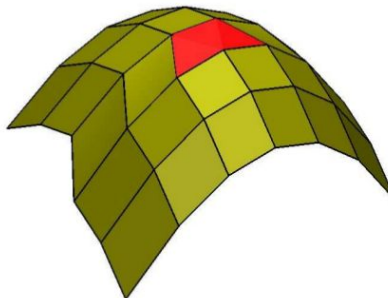
- well-suited for *introducing* T-junctions in quad meshes (refinement)
- **not** naturally suited for creating smooth surfaces from *given* quad meshes with T-junctions.



T-junctions → Catmull-Clark subdivision?



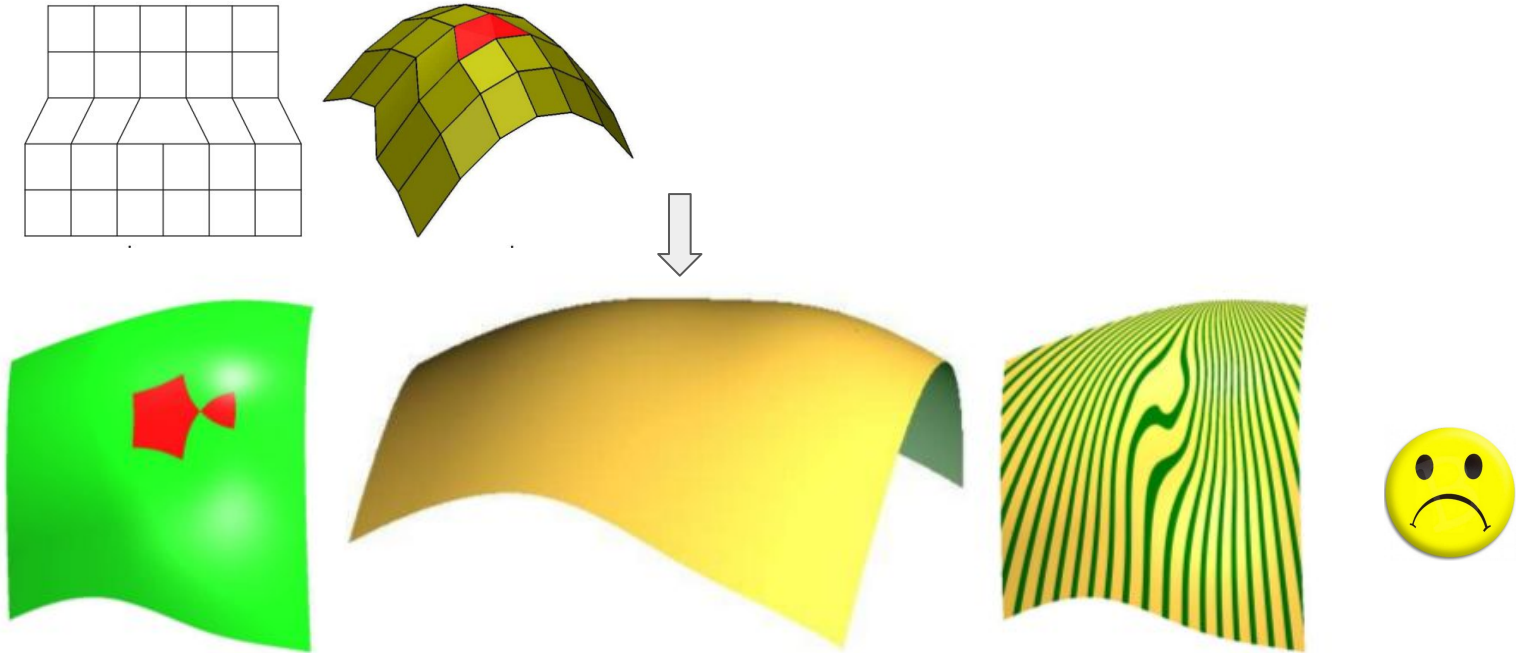
(a) \dot{T} -net layout



(b) convex \dot{T} -net

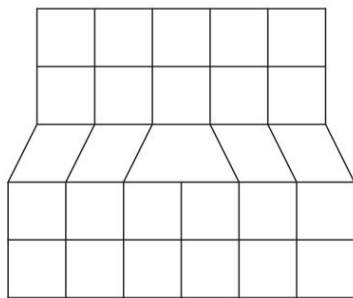
How Catmull-Clark subdivision fails

T-junctions in Spline Surfaces

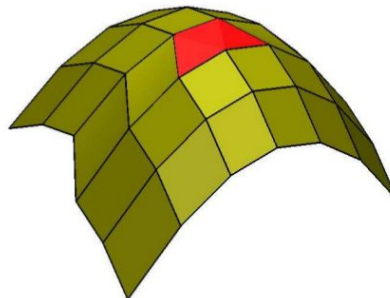


T-junctions → Geometric Continuity?

T-junctions in Spline Surfaces



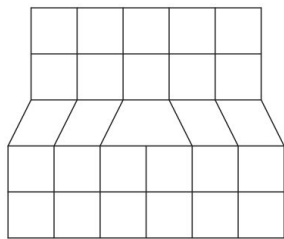
(a) \dot{T} -net layout



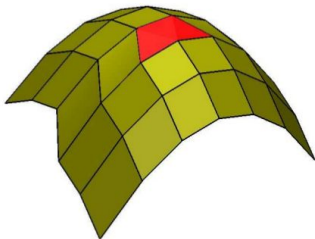
(b) convex \dot{T} -net

T1-G-spline surface construction

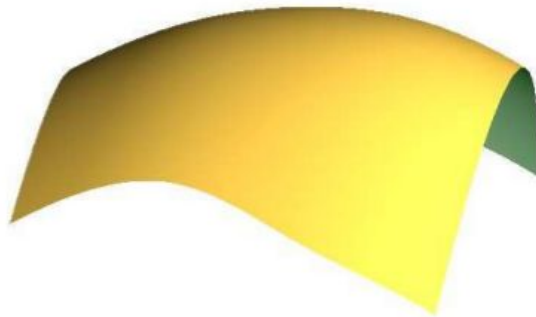
T-junctions in Spline Surfaces



(a) \dot{T} -net layout

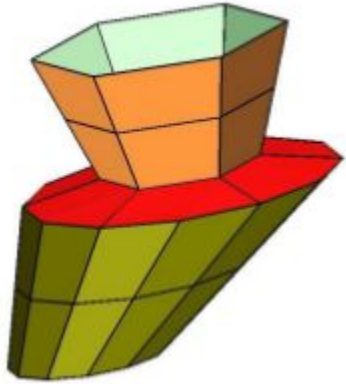


(b) convex \dot{T} -net

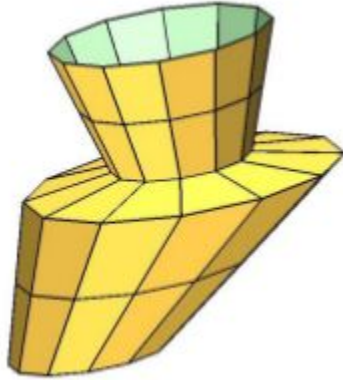


(T)-spline vs T-G-spline

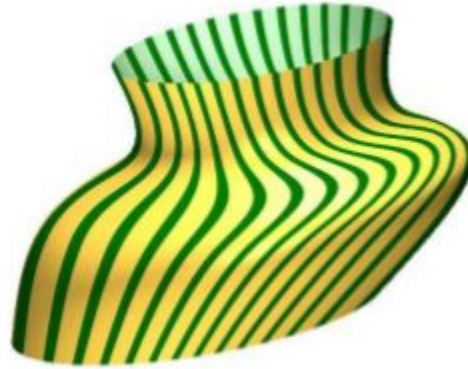
T-junctions in Spline Surfaces



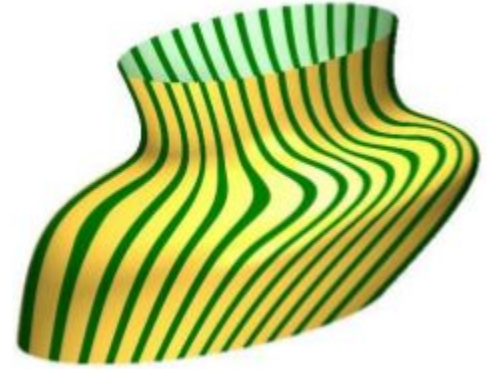
input



remesh



(T-) spline



T-G-spline

Summary: T-junctions in spline surfaces

T-splines (global parameterization)

Catmull-Clark (local, shape?)

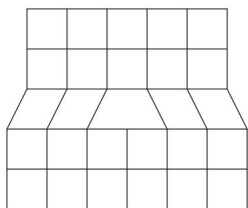
T-G-splines (local)



Long version: Overview

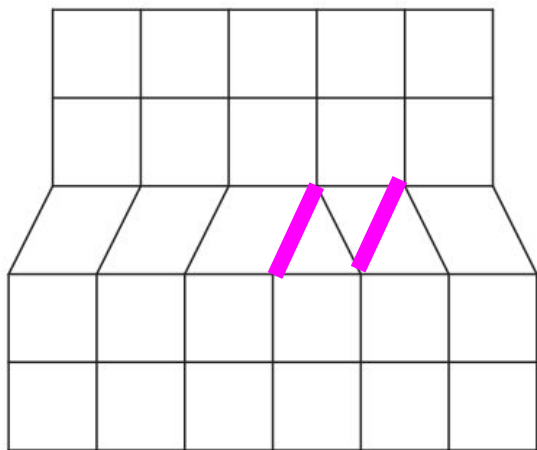
- Some T-configurations
- Alternatives
 - T-junctions → T-splines ?
 - T-junctions → Catmull-Clark subdivision ?
 - T-junctions → Geometric continuity ?
- **Construction**
- T-G-splines = merging meshes T1 T2 T3

T1-G-spline surface construction

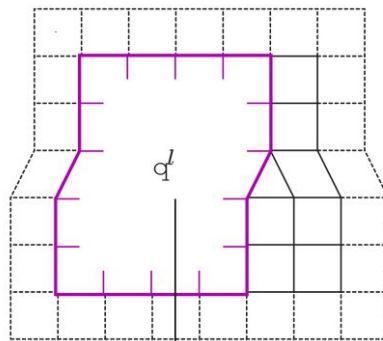


(a) \dot{T} -net layout

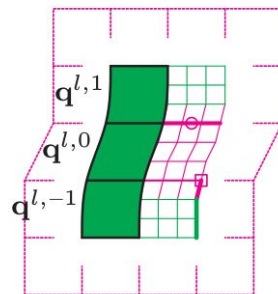
T1



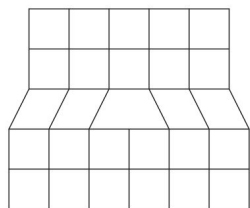
(a) \dot{T} -net layout



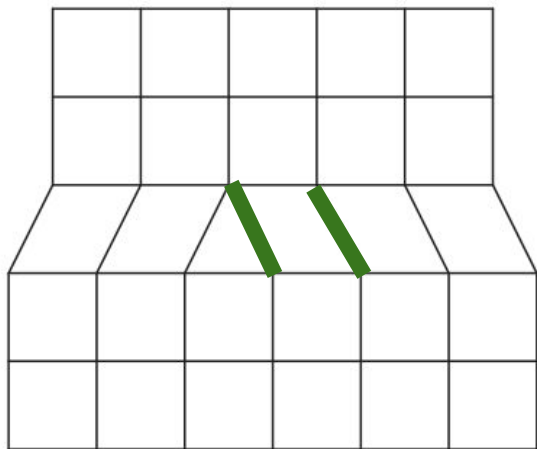
(a) q^l



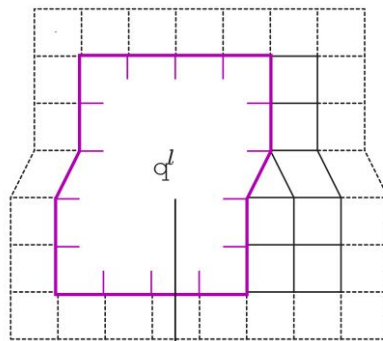
T1-G-spline surface construction



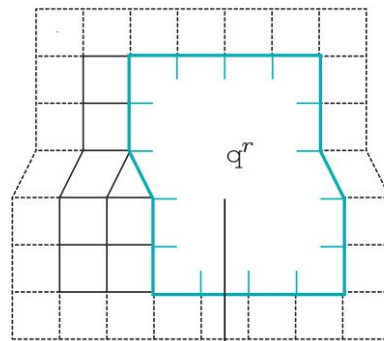
(a) \dot{T} -net layout



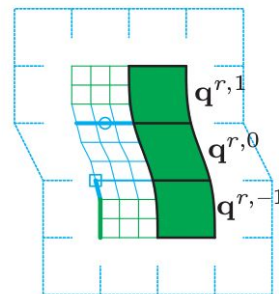
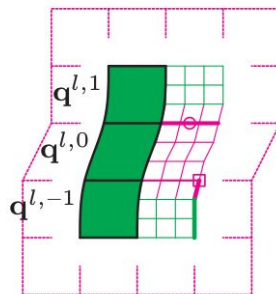
(a) \dot{T} -net layout



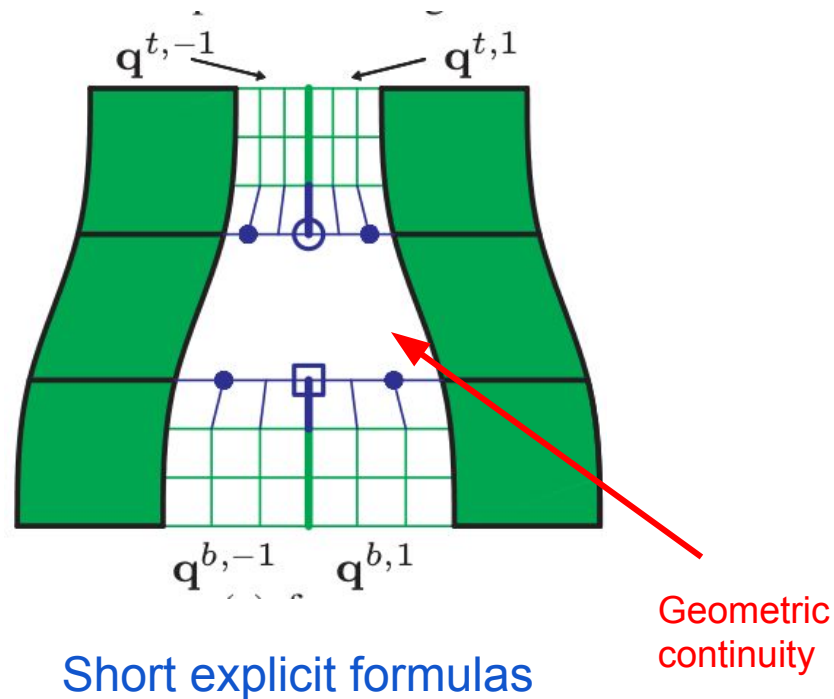
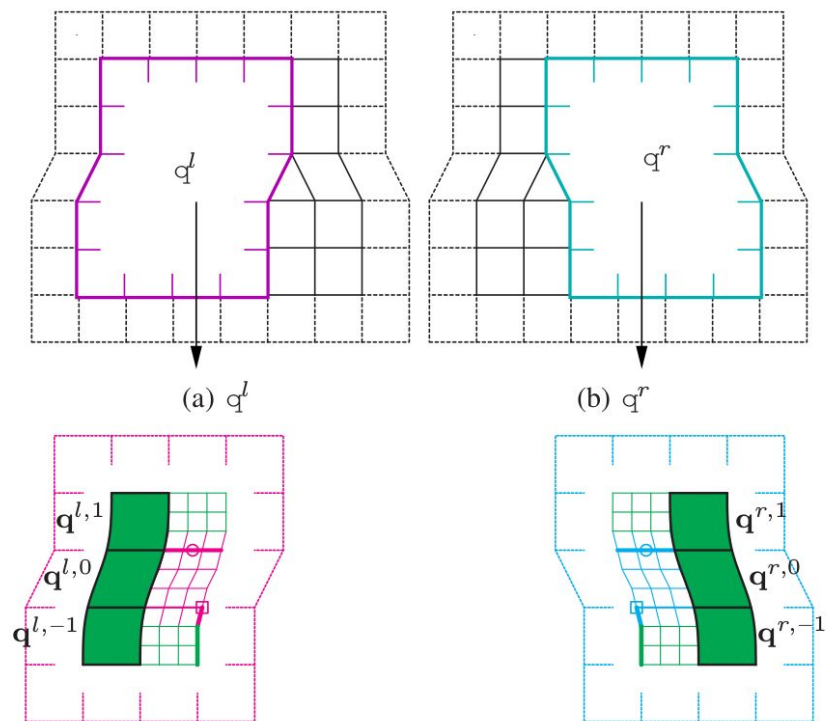
(a) q^l



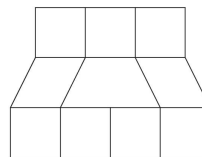
(b) q^r



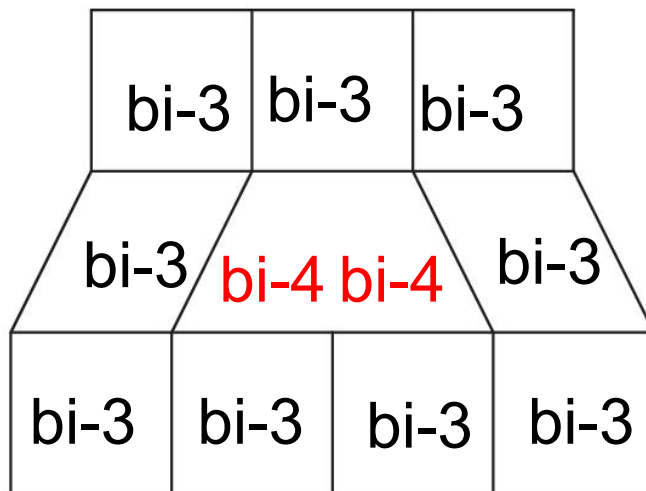
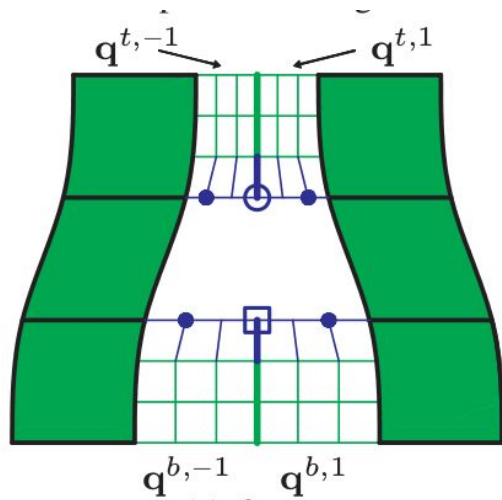
T1-G-spline surface construction



T1-G-spline surface construction

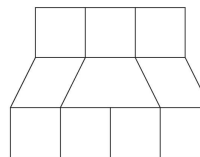


T-junctions in Spline Surfaces



Short explicit formulas

T1-G-spline surface construction



T-junctions in Spline Surfaces

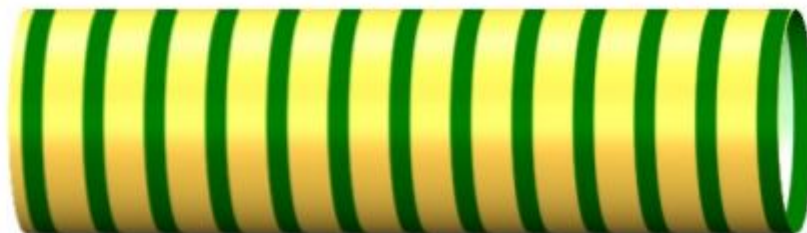
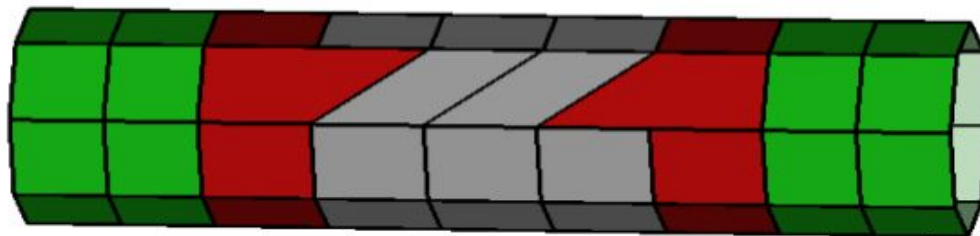
$$\begin{array}{ccccc}
 \begin{bmatrix} 4 & 16 & 16 & 4 & 0 & 0 \\ 4 & 16 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{5}{3} & 16 & \frac{11}{3} & 0 & 0 \\ \frac{5}{10} & 16 & \frac{11}{22} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{3}{6} & 15 & \frac{15}{30} & 0 & 0 \\ \frac{11}{13} & 13 & \frac{11}{4} & 1 & -\frac{1}{8} \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{7}{8} & \frac{107}{8} & \frac{77}{8} & \frac{1}{8} & 0 \\ \frac{7}{8} & \frac{107}{8} & \frac{77}{8} & \frac{1}{8} & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{2} & \frac{23}{2} & \frac{23}{2} & \frac{1}{2} & 0 \\ \frac{1}{2} & \frac{23}{2} & \frac{23}{2} & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 1 & 4 & 1 & 0 & 0 & 0 \\ 7 & 16 & 64 & 7 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{2} & 4 & \frac{7}{2} & 0 & 0 \\ \frac{17}{2} & 64 & \frac{47}{2} & 0 & 0 \\ 4 & 28 & 10 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{5} & \frac{11}{4} & \frac{21}{8} & 0 & 0 \\ \frac{67}{32} & \frac{85}{4} & \frac{267}{16} & \frac{2}{4} & -\frac{2}{32} \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} \frac{1}{8} & \frac{21}{8} & \frac{21}{8} & \frac{1}{8} & 0 \\ \frac{25}{8} & \frac{413}{8} & \frac{313}{8} & \frac{1}{8} & 0 \\ 1 & 15 & \frac{161}{2} & 6 & -\frac{1}{8} \end{bmatrix} & \begin{bmatrix} \frac{1}{2} & \frac{23}{2} & \frac{23}{2} & \frac{1}{2} & 0 \\ \frac{7}{16} & \frac{21}{2} & \frac{161}{8} & \frac{21}{2} & \frac{7}{16} \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 12 & 12 & 48 & 12 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 6 & 48 & 18 & \frac{15}{2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} -\frac{1}{6} & -\frac{1}{43} & \frac{1}{25} & 0 & 0 \\ \frac{7}{6} & \frac{115}{8} & \frac{31}{2} & \frac{4}{8} & -\frac{1}{6} \\ 0 & \frac{1}{8} & -\frac{1}{2} & 0 & 0 \end{bmatrix} & \begin{bmatrix} -\frac{1}{16} & -\frac{5}{16} & \frac{5}{16} & \frac{1}{16} & 0 \\ \frac{2}{16} & \frac{47}{8} & \frac{87}{8} & \frac{2}{4} & -\frac{1}{16} \\ 0 & \frac{1}{4} & 0 & -\frac{1}{4} & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{4} & 14 & \frac{87}{2} & 14 & \frac{1}{4} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 16 & 7 & 64 & 28 & 7 & 0 \\ 1 & 4 & 1 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{11}{2} & 64 & \frac{53}{2} & 0 & 0 & 0 \\ \frac{1}{2} & 4 & \frac{11}{2} & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 25 & 14 & 0 & \frac{1}{2} & 0 \\ 0 & 4 & 2 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{52}{2} & 64 & \frac{5}{2} & 0 & 0 \\ 0 & \frac{17}{5} & 4 & -\frac{1}{5} & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 16 & 64 & 16 & 0 & 0 \\ 0 & 1 & 4 & 1 & 0 & 0 \end{bmatrix} \\
 \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 16 & 4 & 16 & 4 & 0 & 0 \\ 4 & 16 & 4 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 4 & 16 & 7 & 0 & 0 & 0 \\ 1 & 16 & 7 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 14 & 8 & 0 & 1 & 0 \\ 0 & 12 & 12 & 0 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 2 & \frac{23}{2} & \frac{17}{2} & 2 & 0 & 0 \\ 0 & 28 & 64 & 4 & 0 & 0 \end{bmatrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 10 & 10 & 16 & 0 & 0 \\ 0 & 4 & 16 & 4 & 0 & 0 \end{bmatrix}
 \end{array}$$

Short explicit formulas

/144

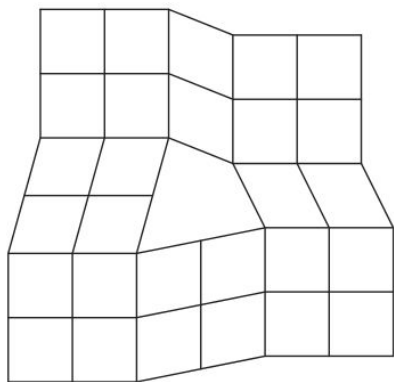
T1-G-spline surface construction

T-junctions in Spline Surfaces

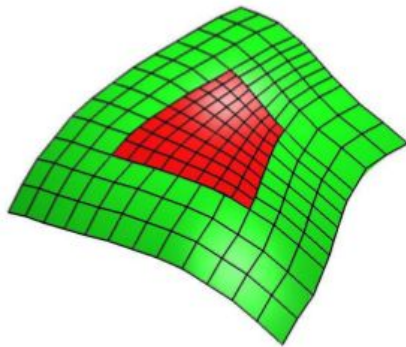
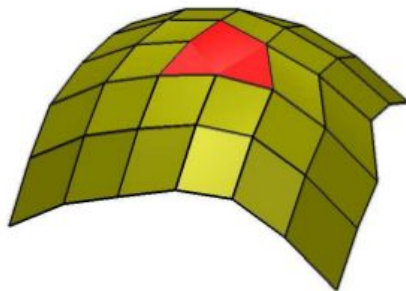
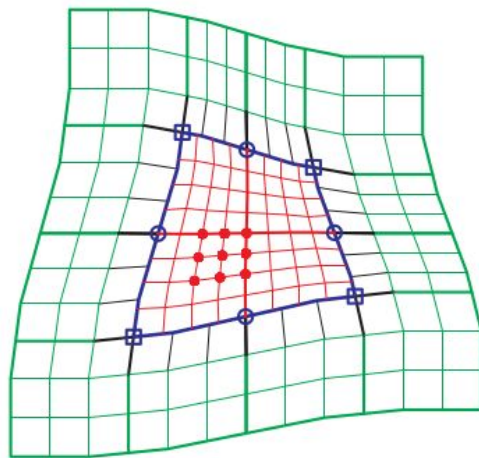


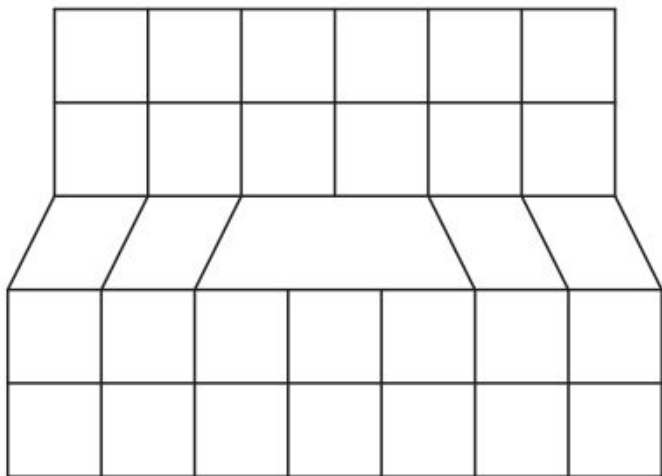
T2-G-spline surface construction

T-junctions in Spline Surfaces

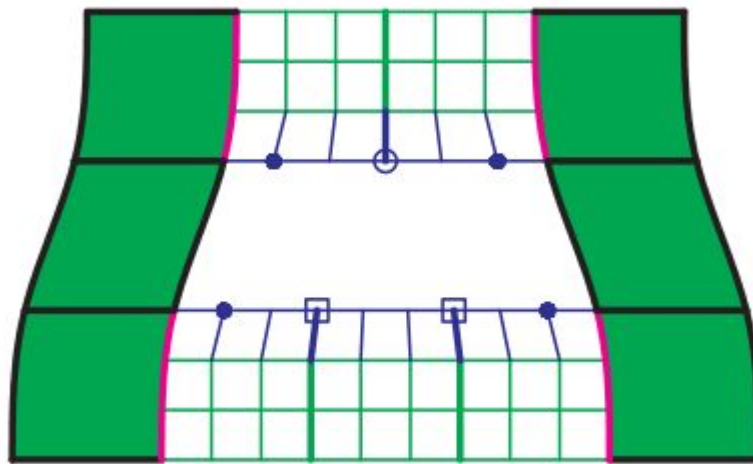


(a) \ddot{T} -net





(b) \ddot{T} -net

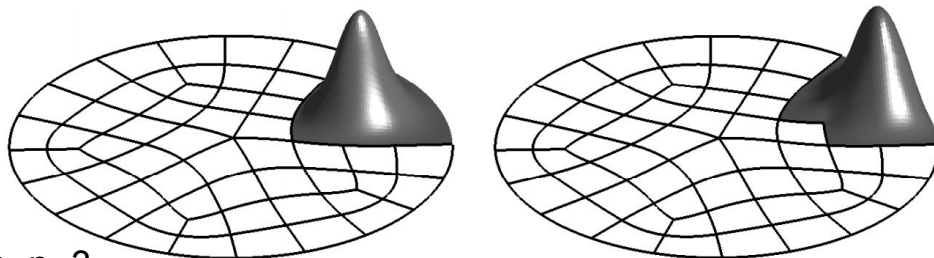


T3

- Some T-configurations
- Alternatives
 - T-junctions → T-splines ?
 - T-junctions → Catmull-Clark subdivision ?
 - T-junctions → Geometric continuity ?
- Construction T1 T2 T3
- **T-G-splines**

Long version: Overview

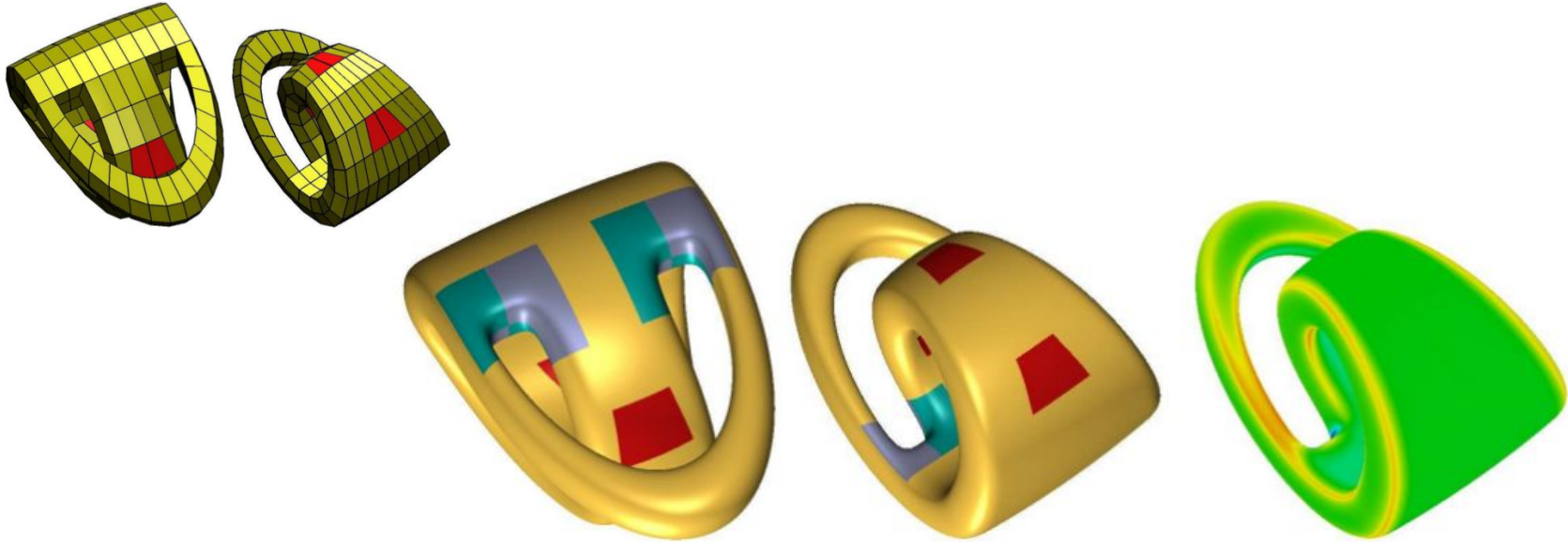
- Some T-configurations
- Alternatives
 - T-junctions → T-splines ?
 - T-junctions → Catmull-Clark subdivision ?
 - T-junctions → Geometric continuity ?
- Construction T1 T2 T3
- **T-G-splines**



valence $n=3$

Combining T-junctions with other irregularities

T-junctions in Spline Surfaces

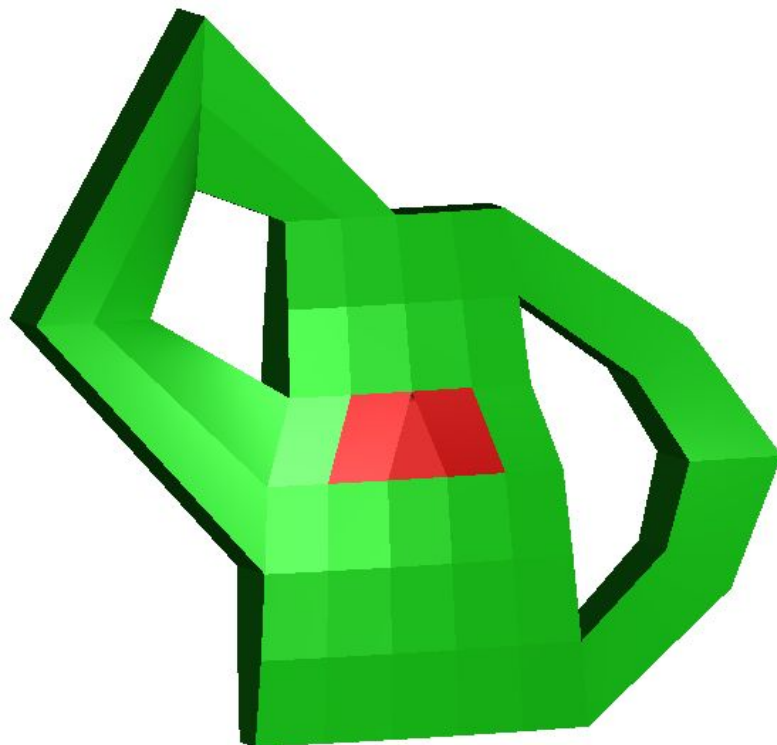


bi-3 (gold) + bi-4 T-G-spline

mean curvature

T3-G-spline surface construction

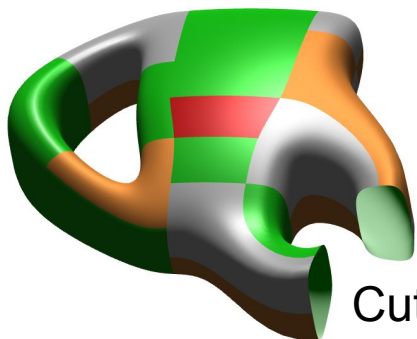
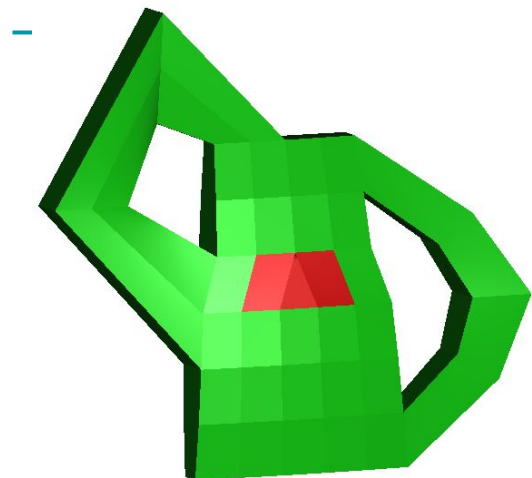
T-junctions in Spline Surfaces



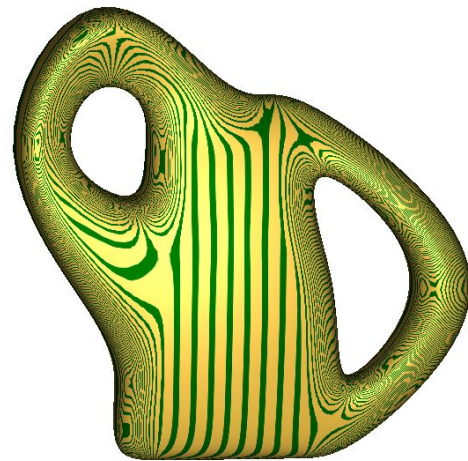
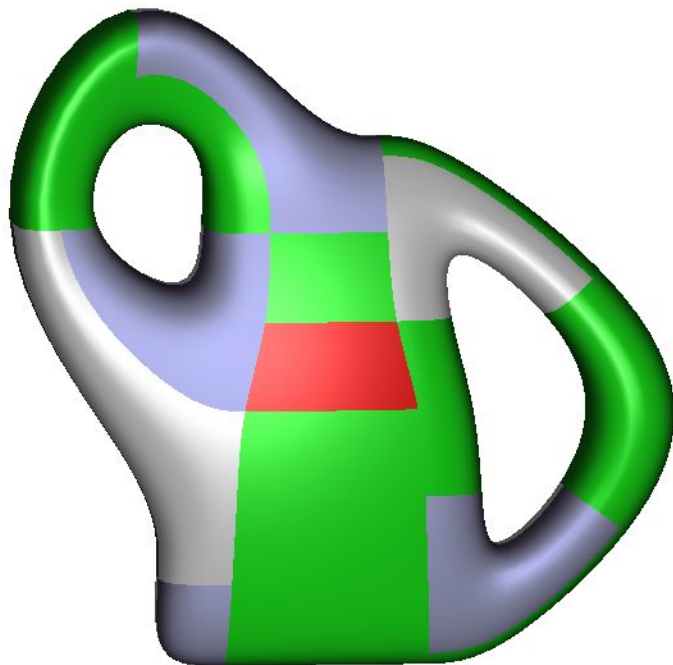
A truly
watertight
tea pot!

T3-G-spline surface construction of the *truly watertight* tea pot

T-junctions in Spline Surfaces



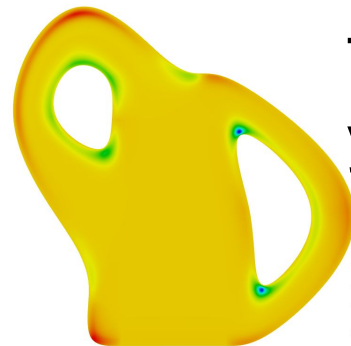
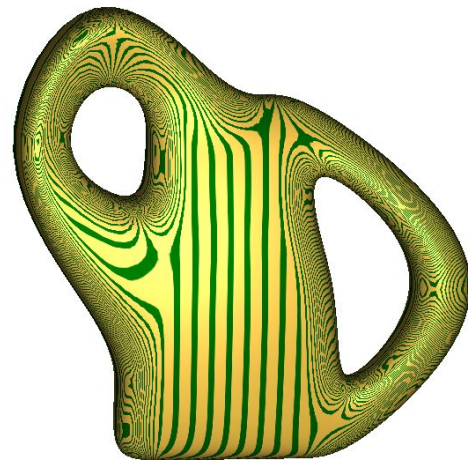
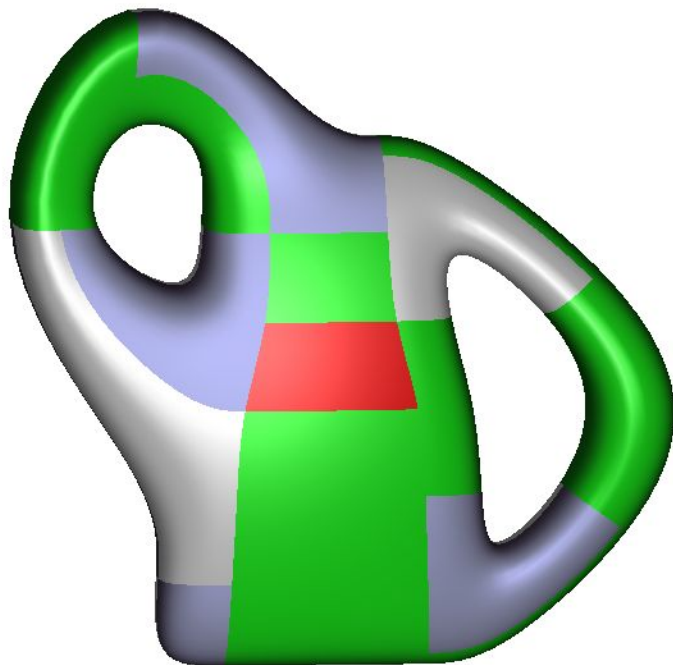
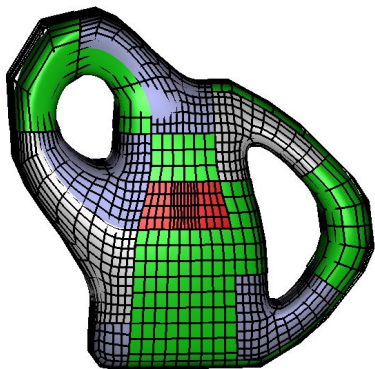
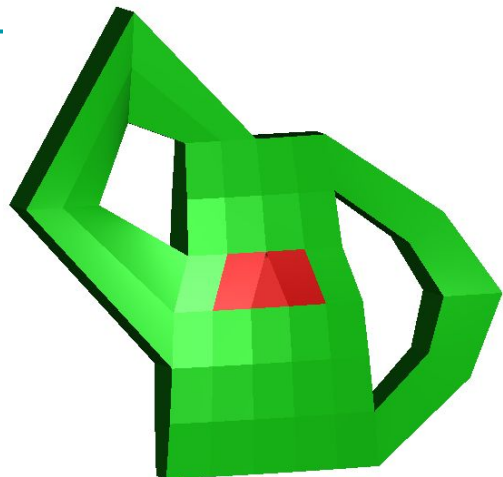
Cut open



T3-G-spline surface construction of the *truly watertight* tea pot

K Karciauskas, D Panozzo, Jorg Peters

T-junctions in Spline Surfaces



Thank
you

