

Applied Geometry and special effects 2010

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Architecture

Modular

- Component-driven Objects, build objects from pieces of logic (aggregation) instead of inheritance.

- Data-driven

- Script

- Define components in Lua script
 - Curve evaluation components, special effects components, etc.
 - C++ engine exposure via intuitive syntax
 - Scene initialization definition

- XML

- Define entities
 - Aggregation of components
 - Set initial property values
 - Engine configuration

Architecture

Multi-threaded curve evaluation

- Parametric curve points are independent
- Potentially millions of points on curve to evaluate
- Spawn worker-thread pool equal to number of cores
- Each evaluation is a job on a job-queue
- Workers pop jobs from queue
- Evaluate curve in parallel

Curves

B-Spline

- $n+1$ control points *cpts*
- Degree d
- $n+d+2$ knots
- t is the interpolated parametric value between start and end of the parametric interval (the curve).
- Generate Bernstein-Hermite matrix, *BHM*, that holds the polynomials based on t .
- The pointset p is the point on the curve at t and all its derivatives.
- We find p on the B-Spline curve by using the *BHM* to weight the *cpts*



Curves

Expo-Rational B-Spline (ERBS)

- Input curve
 - Define number of local curves, n/c , and the degree of the polynomials d
 - Look at n/c number of points, p_i , on input curve and the $d-1$ derivatives of each p_i to define the local pointset p .
 - For each p , we multiply by the inverse Bernstein-Hermite matrix to find the control-points, $cpts$, for each local curve of the ERBS.
- Evaluate curve by blending two local curves for each pointset based on the t interval

Quad-tree evaluation

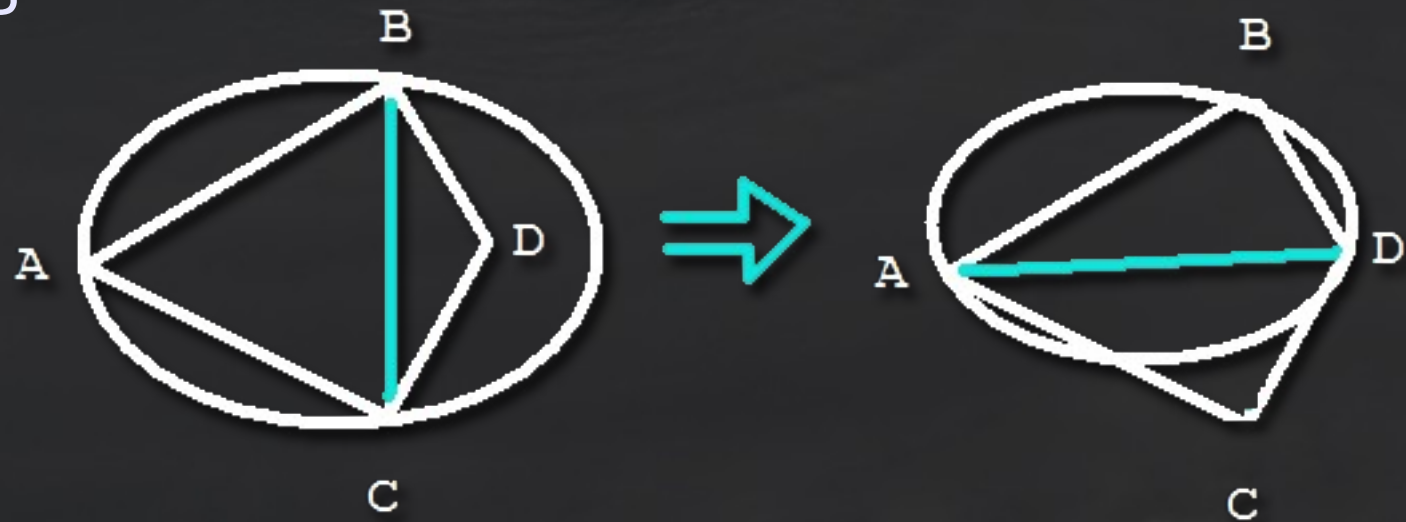
Organization of data in quadrants

- Can be used to, for example, look up a specific pixel in a 2D image
- Each node in tree represent a region
- Split when maximum capacity of region is reached
- Splits in four children at each level of the Quad-tree
- Steiner product

Triangulation

Delaunay

- Triangulates a set of points
- Must adhere to the *Delaunay condition*
 - The circle c through abd can not contain any points
 - If sum of the angle of the adjacent point in the new triangle is lequal to 180 degrees.
 - FLIP



Project

Input curve of ERBS specified via lua script component

- Rose, Butterfly, Spiral
- Special effects written in lua script component
- Curves defined in XML
- Scene defined in Script
- Curve, Bezier and ERBS PCurve objects defined in C++, and inherits from IEntity
- Very easy to define new input curves in script
- Very easy to add new special effects in script
- Little to no recompilation of code required to expand project!



DEMO