Applied Geometry and special effects 2010

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Introduction

- Architecture
- Curves
- Triangulation
- Quad-tree
- Project
- Demo

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 paramertric 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)
  - C∞-Smooth (can never derivate to 0)
  - Construction
    - Define number of local curves, *nlc*, and the degree of the polynomials *d*
    - Look at *nlc* number of points, *pi,* on input curve and the *d*-1 derivatives of each pi 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

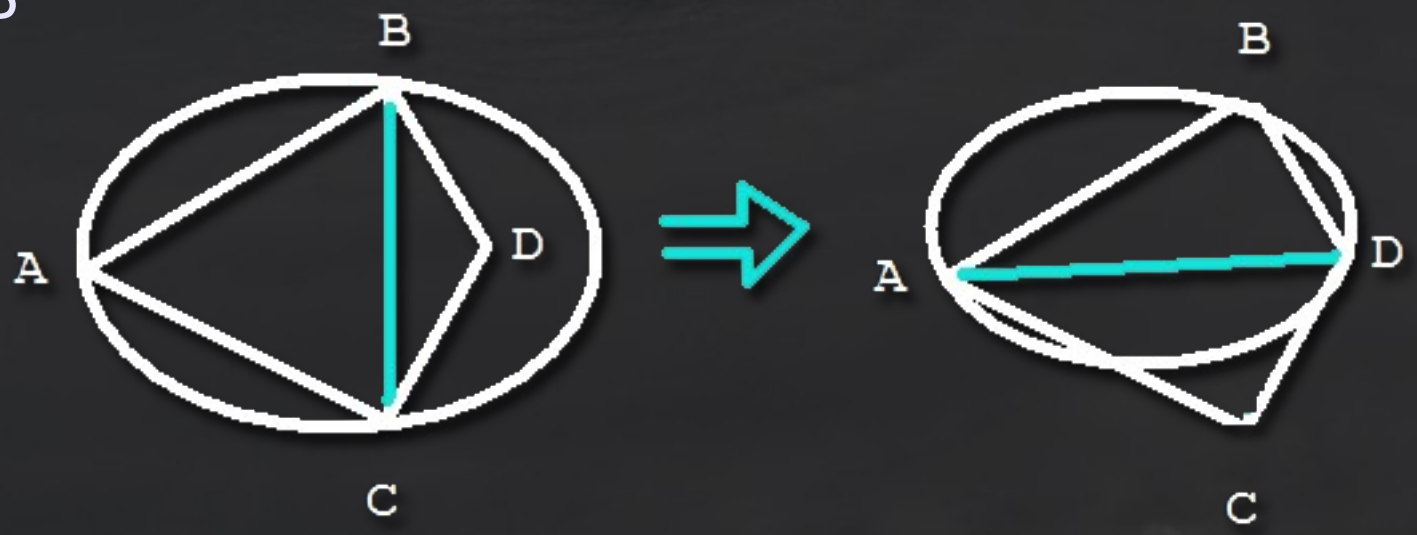
Quad-tree evaluation

- 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 adher to the *Delaunay condition*
  - The circle *x* through *abc* 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