

An inexpensive bounding representation for offsets of quadratic curves

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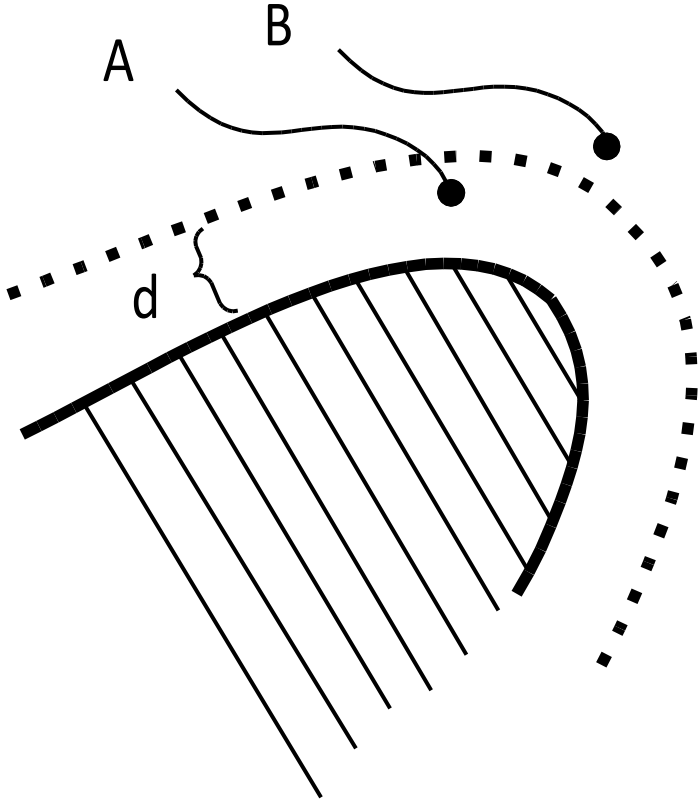
point-curve distance

- used in
 - graphics (antialiasing, brush effects, warping)
 - manufacturing (tool planning)
 - road navigation
 - level set computation
- expensive to compute

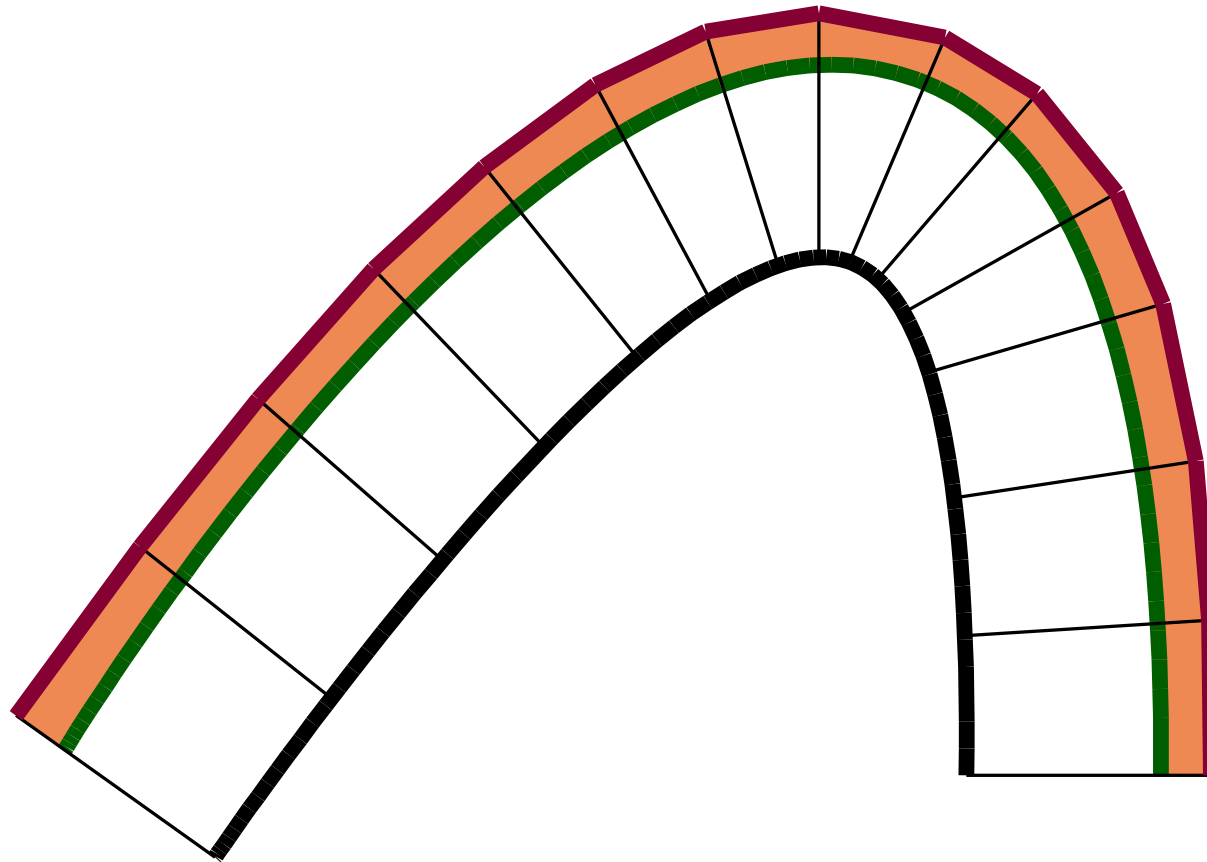
related work

- approximation
 - Loop & Blinn '05, Nehab & Hoppe '08
- iterative solvers
 - Wang et al '02, Qin et al. '08
- acceleration, bounding structures
 - Kay & Kajiya '86, Arvo & Kirk '87
 - Bentley '75, Guttman '84
- offset curves
 - Tiller & Hansen '84, Farin '89, Elber et al. '97

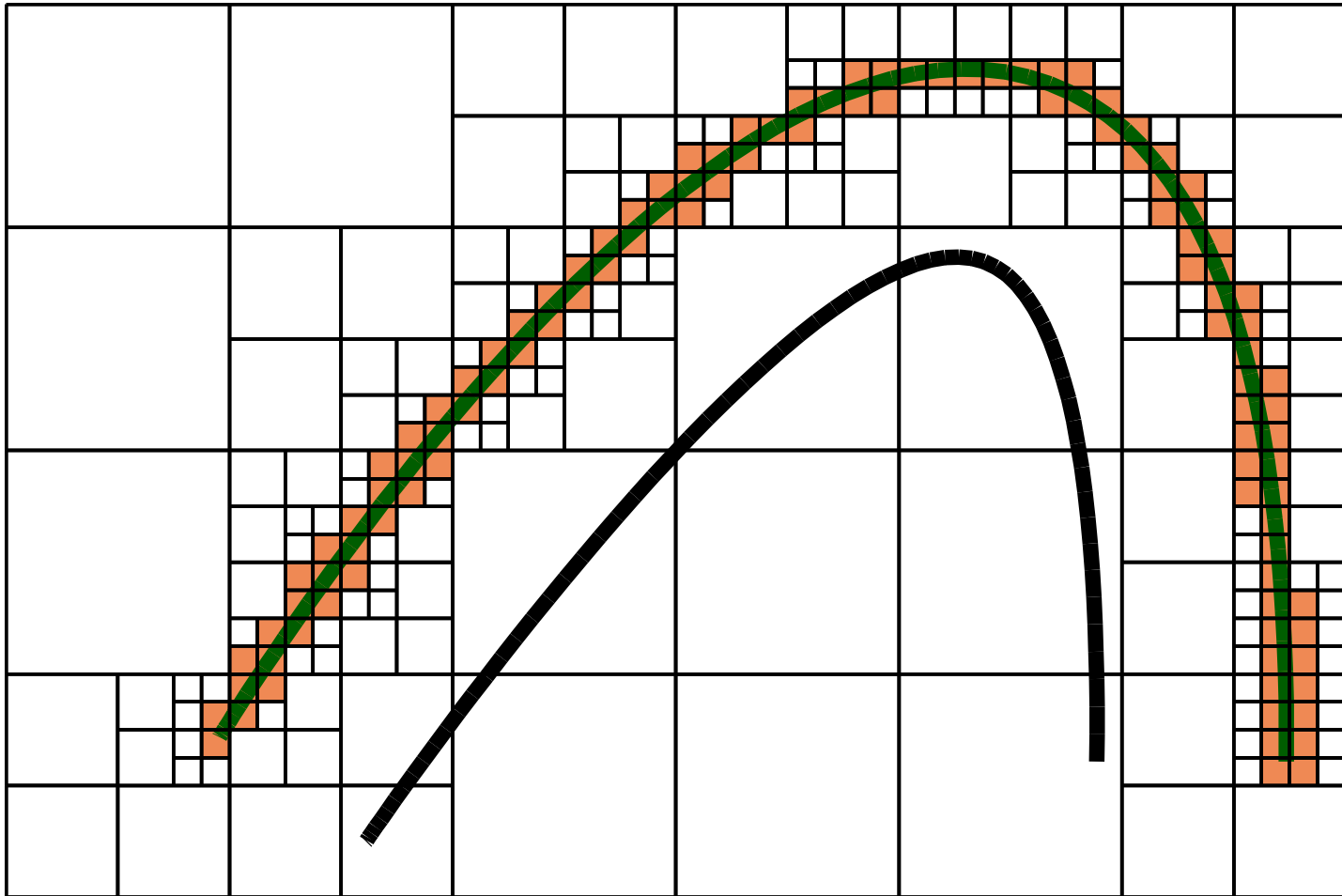
accelerating bounded distance queries



1. model offset curve



2. model bounding space



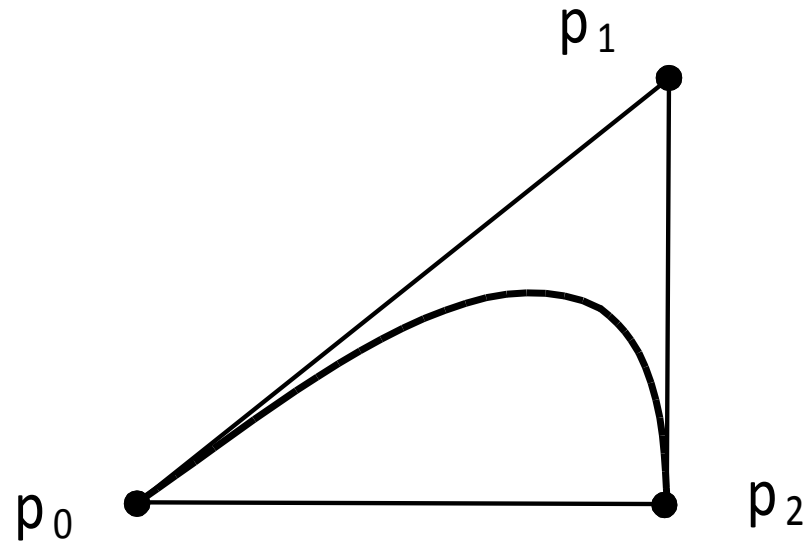
3. single approximate offset curve



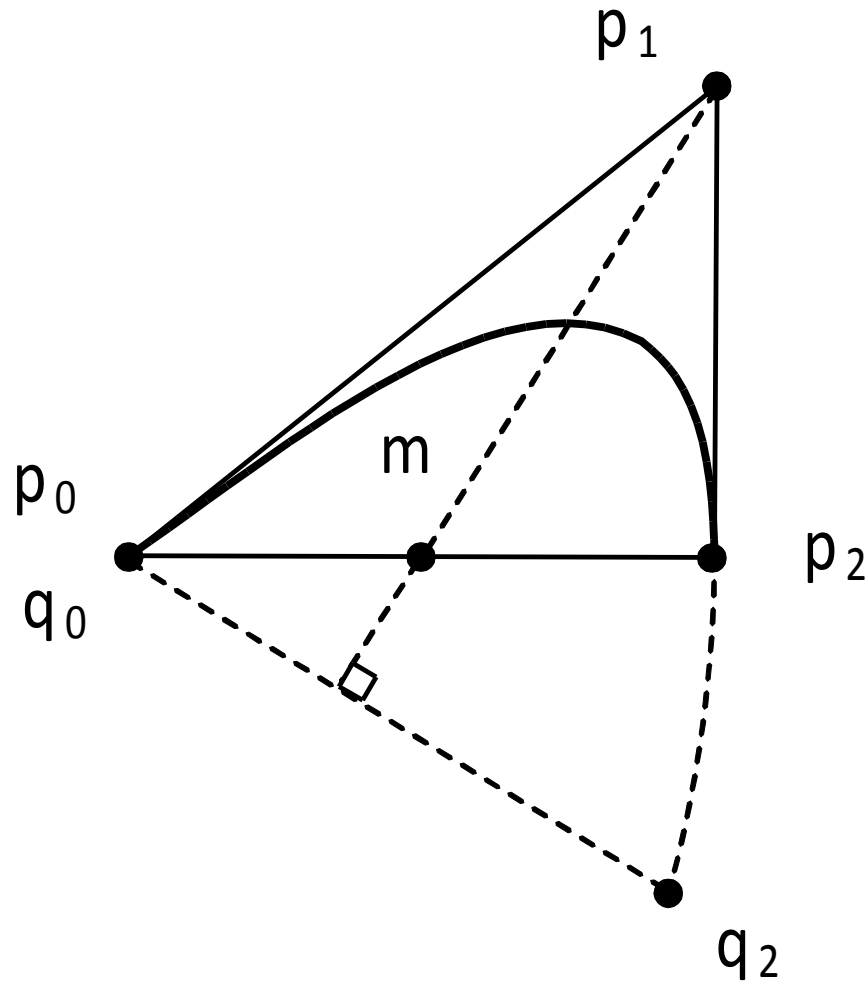
this talk

- quadratic Bezier curves
- approximate 6th-order precise offset curve with another quadratic curve
- evaluate utility vs. ideal offset curve

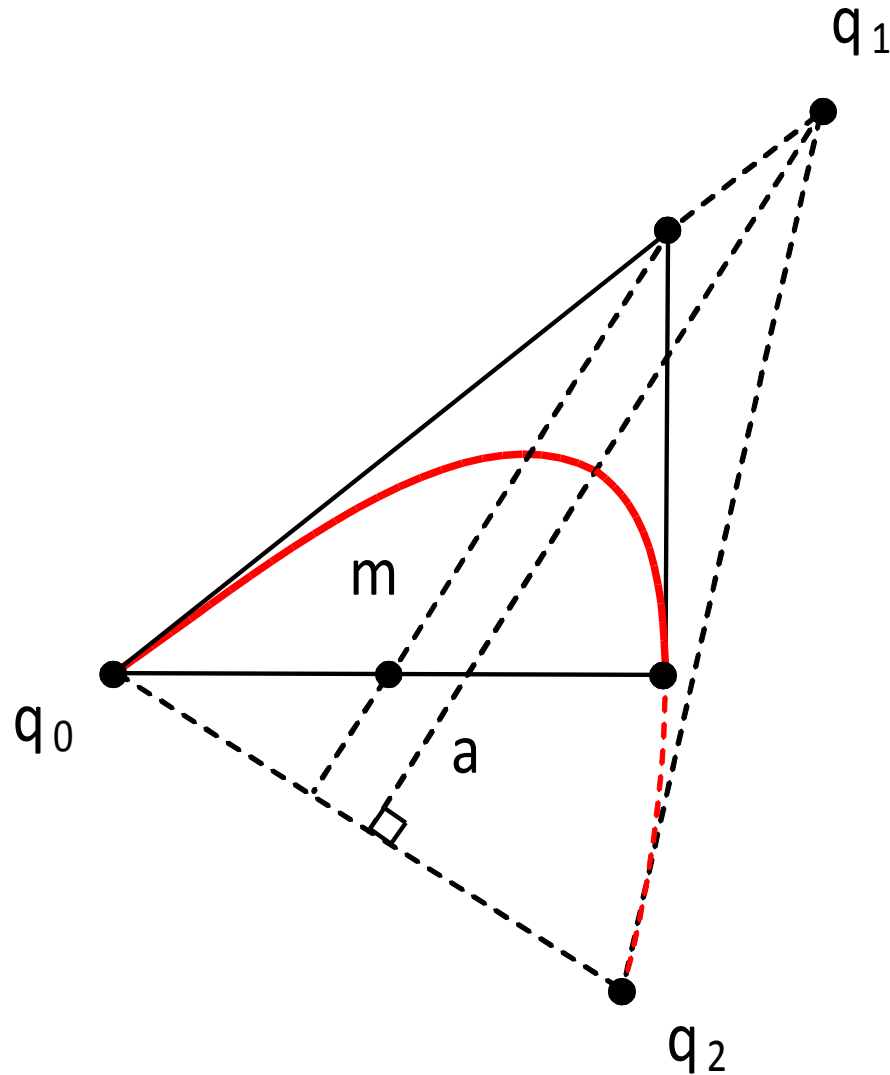
initial curve



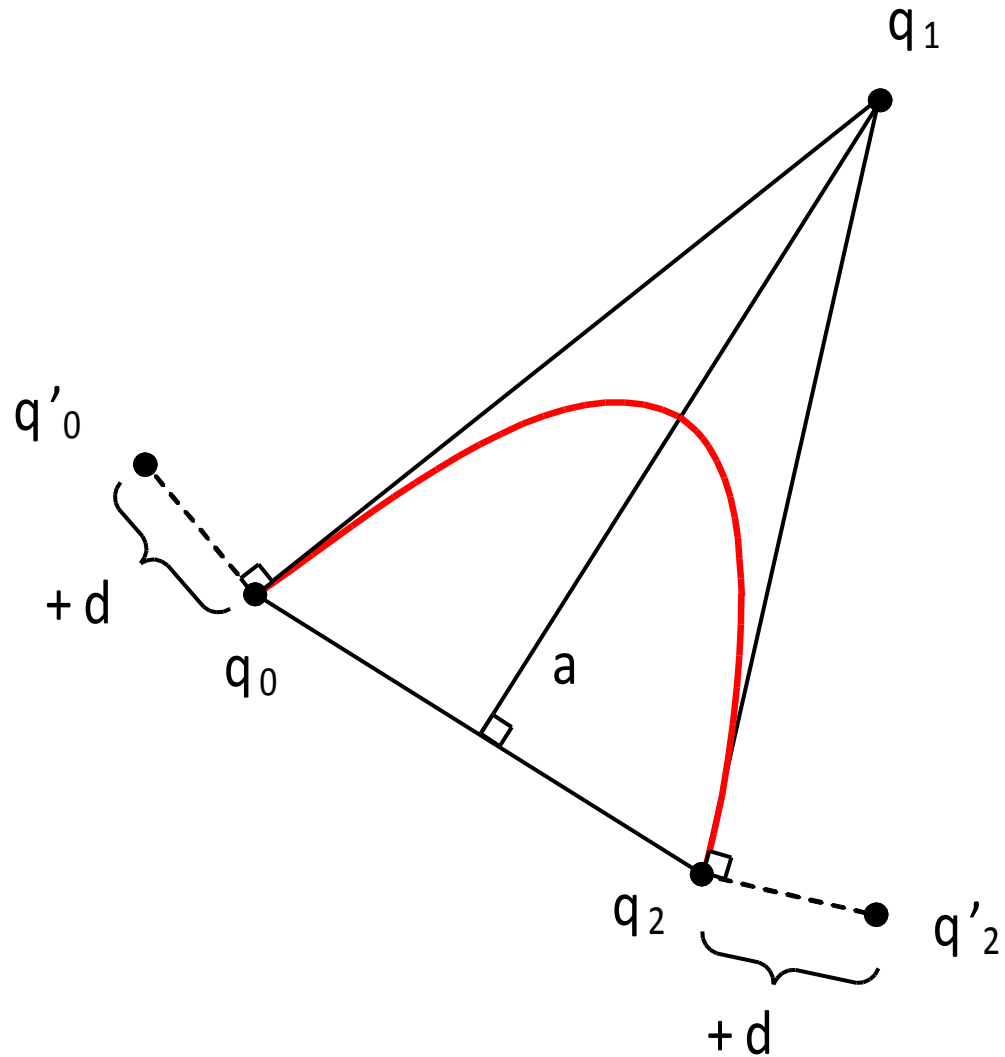
discover symmetric endpoint



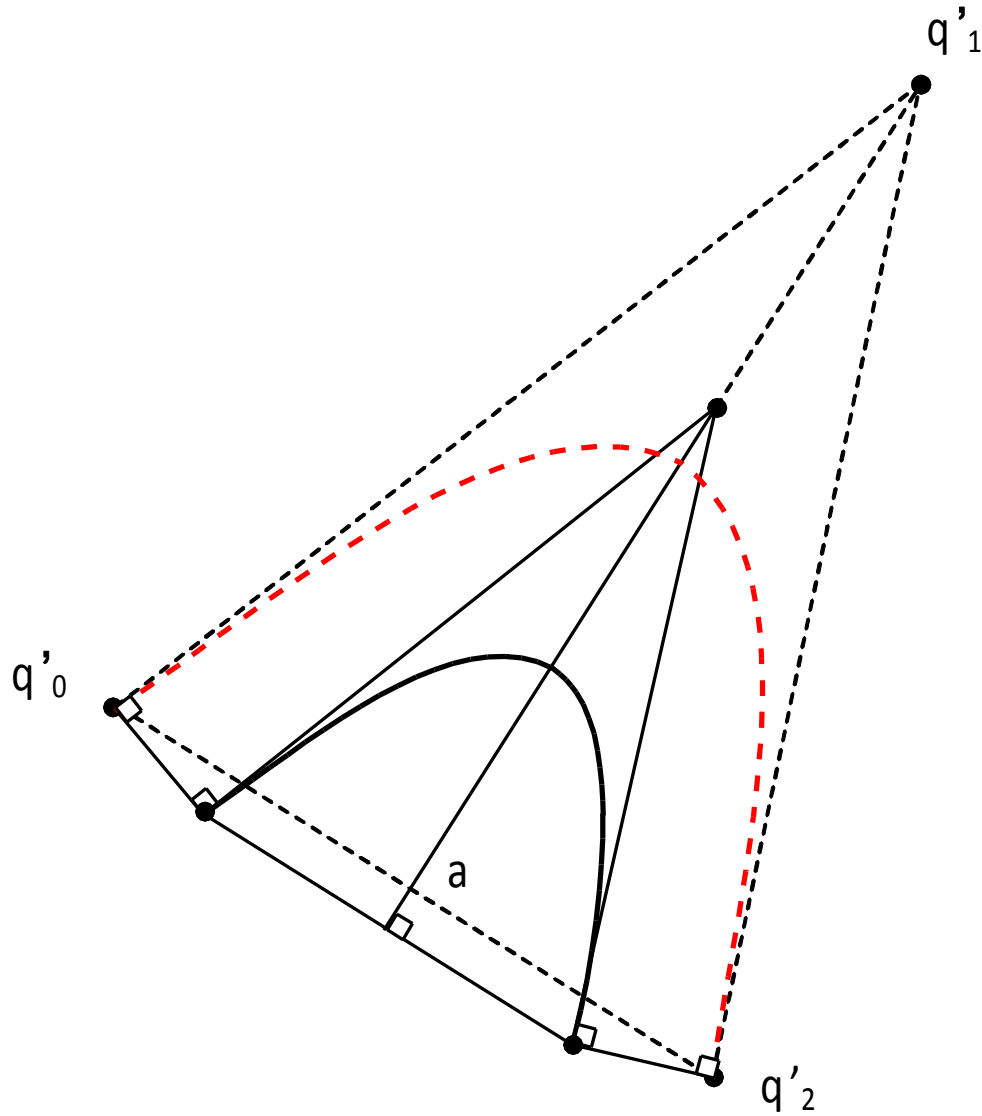
construct symmetric triangle



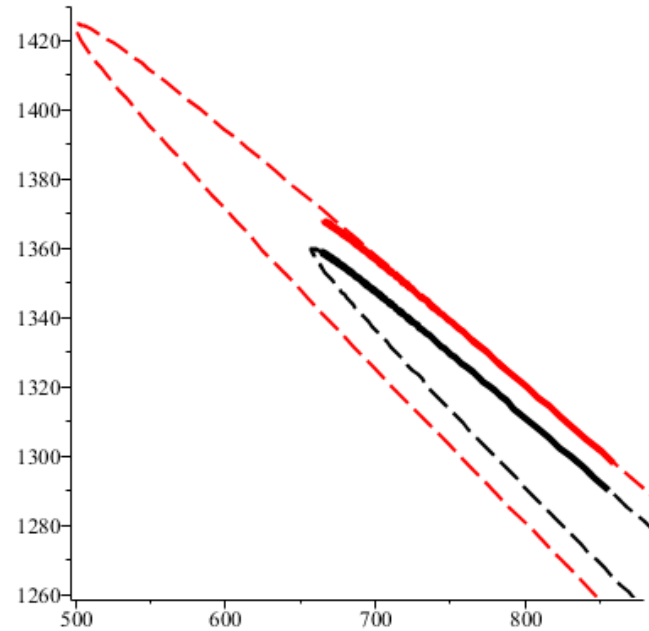
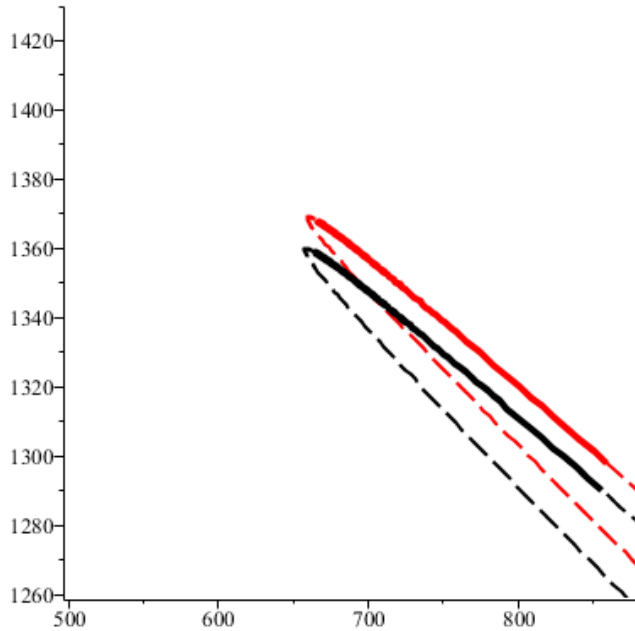
bump endpoints with normals



extend new tangents



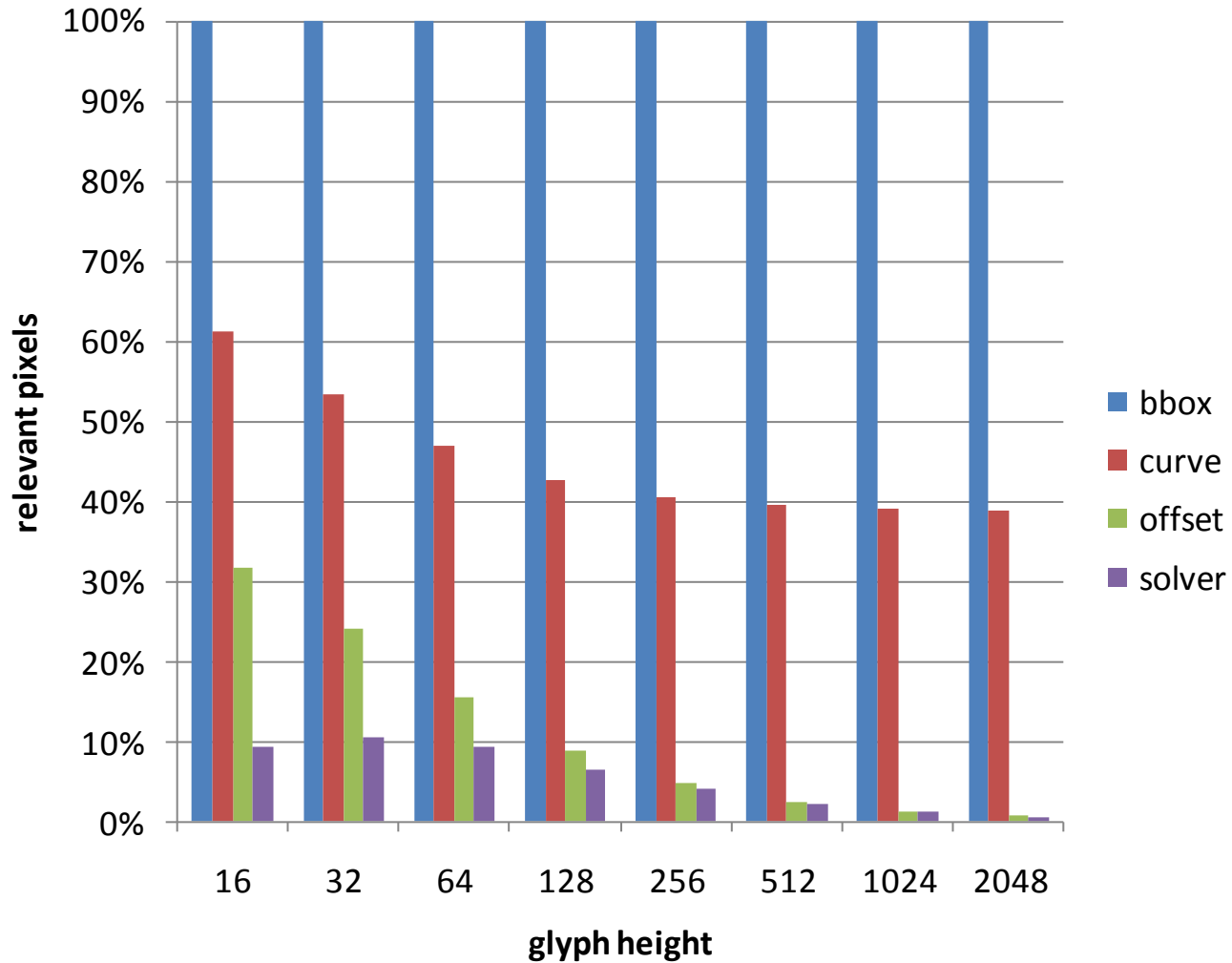
why symmetry matters



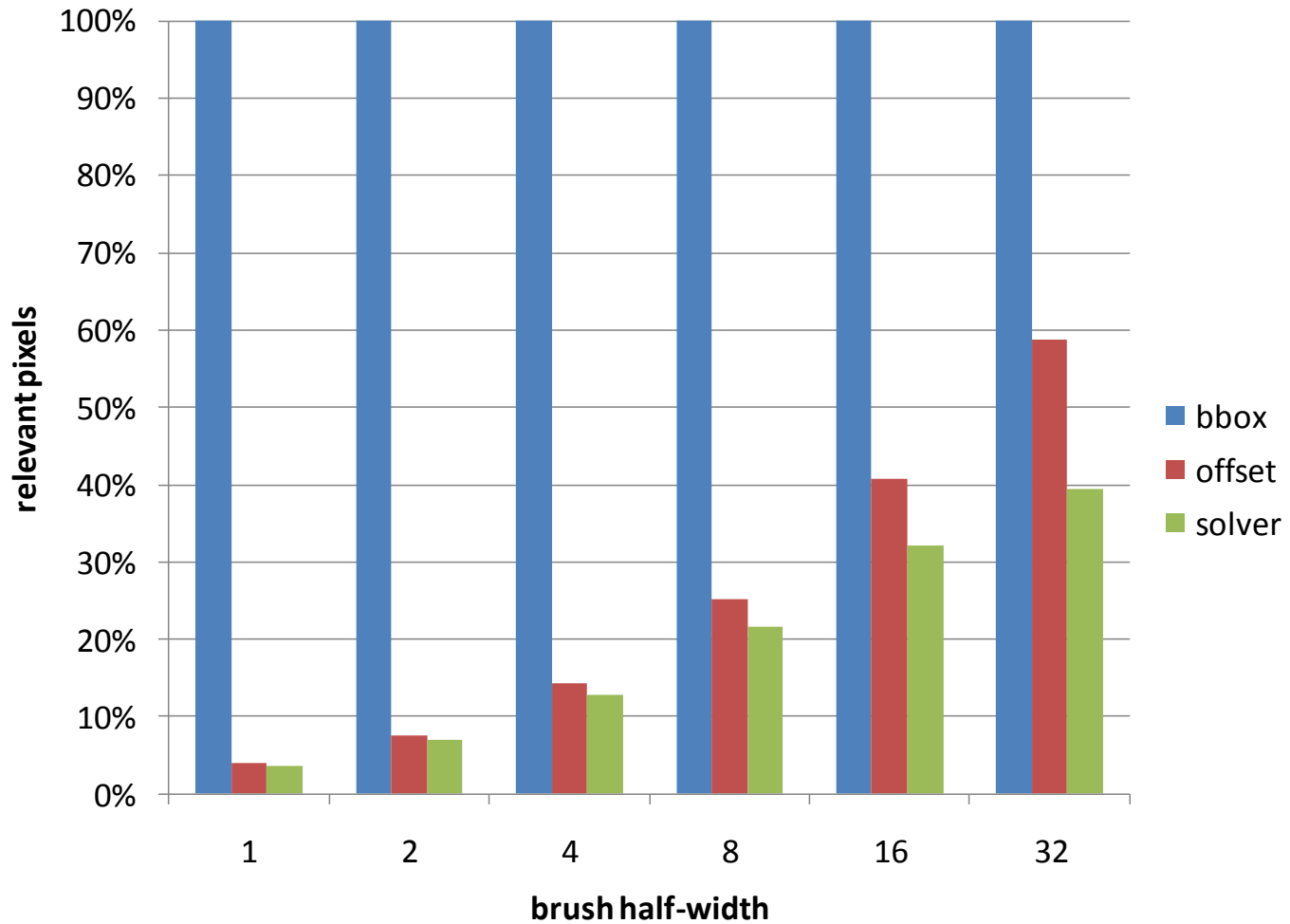
experiments

- 2000 curve segments from TrueType fonts
- antialiasing scenario
 - fixed 1-pixel exterior offset
 - varying glyph size
- brush scenario
 - varying offset value
 - fixed segment size
- metric: % of pixels deemed relevant

relevant pixels (antialiasing)



relevant pixels (brush)



future work

- implementation
 - CPU, GPU, FPGA
 - evaluate performance in actual renderer
- more curve types
 - more complex base and offset curves
 - conics (rational quadratics) have
 - symmetry
 - simple implicit function

conclusion

- (imprecise) offset curves as accelerators
- quadratic curve as offset to quadratic curve
 - useful
 - discharges 66-99% of out-of-range queries
 - cheap
 - constant-space representation (3 points)
 - constant-time initialization
 - constant-time evaluation