

Geometric Tools Engine 7 Update History

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The version release dates are listed here. Versions released before the current version may be obtained by email request.

- Version 7.0 posted January 7, 2024.

The updated files and related notes are provided for the versions in each of the ensuing sections. Each section has a list of changes that occurred to the version number mentioned in that section. Those changes were rolled up into the zip file that was posted for the next version. Modified files are colored [gold](#), new files are colored [green](#), and deleted files are colored [red](#). Source code is colored [violet](#).

1 Updates to Version 7.0

March 25, 2024. Modified the [FindNeighbors](#) member function to use a priority queue to improve the speed of queries. Thanks to CodeReclaimers for providing the speed-up.

[GTE/Mathematics/NearestNeighborQuery.h](#)

March 24, 2024. The classes [IntpQuadraticNonuniform2](#) for GTE and GTL pass the same unit tests, and those results were verified by Mathematica for the GTL class. The rendering in the interpolation sample application clearly showed the derivatives did not match at the center triangle of the 4 triangles. It turns out that that sample code itself had a bug. The [SampleMesh](#) class initializes [mAdjacencies](#) to have the triangle indices for neighbors. For the triangle $\langle \mathbf{V}_1, \mathbf{V}_4, \mathbf{V}_3 \rangle$, the adjacencies were assigned as $\langle 0, 1, 2 \rangle$. The assignment needed to be $\langle 1, 2, 0 \rangle$. After this modification, the rendered surface is visually smooth. The window client size was 512×512 , but I made it larger for a better view of the renderings. It is now 768×768 .

[GTE/Samples/Mathematics/Interpolation2D/Interpolation2DMain.cpp](#)
[GTE/Samples/Mathematics/Interpolation2D/Interpolation2DWindow2.cpp](#)

March 23, 2024. My template instantiation system needed serious modification for when I deprecated a class and provided a new implementation. The system failed to instantiate the new implementations. I discovered this when attempting to backport the [IntpQuadraticNonuniform2](#) class (the Cendes–Wong algorithm) from GTL to GTE. The GTL code has been thoroughly unit tested and verified with Mathematica. There are no sample applications that exercise those new implementations, which was clear when the code would not compile—a serious oversight on my part. I have made changes to various classes to get the template instantiation to compile the new code. I will post the backported GTL code for [IntpQuadraticNonuniform2](#) after I unit test the derived classes ([IntpSphere2](#) and [IntpVectorField2](#)).

[GTE/Mathematics/Delaunay2Mesh.h](#)
[GTE/Mathematics/Delaunay3Mesh.h](#)
[GTE/Mathematics/IntpLinearNonuniform2.h](#)
[GTE/Mathematics/IntpLinearNonuniform3.h](#)
[GTE/Mathematics/IntpSphere2.h](#)
[GTE/Mathematics/IntpVectorField2.h](#)

March 13, 2024. Ported the Hermite interpolations from GTE to GTL. Verified the systems of equations and solutions that produce the coefficients of the polynomials, both using code that generates code for

the system and by using Mathematica to solve symbolically the numerous cases. Unit tests for the GTL code are more rigorous than those for GTE, so the GTL code and unit tests were back-ported to GTE. The SmoothLatticeInterpolation.pdf document has been updated significantly to describe the coefficient construction.

GTE/Mathematics/HermiteCubic.h
GTE/Mathematics/HermiteQuintic.h
GTE/Mathematics/HermiteBicubic.h
GTE/Mathematics/HermiteBiquintic.h
GTE/Mathematics/HermiteTricubic.h
GTE/Mathematics/HermiteTriquintic.h

February 25, 2024. Added a new file for fitting a parabola to points $(x, f(x))$. The document [Least Squares Fitting of Data by Linear or Quadratic Structures](#) has been updated with a section describing the algorithm.

GTE/Mathematics/ApprParabola2.h

Fixed minor issues after porting the code and unit tests to GTL: Removed test code. The `isUnique` value was set to `false` when the intersection of intervals is a nondegenerate interval. Instead, `isUnique` must be set to `true` when the w -values are the same at the interval endpoints, `false` otherwise.

GTE/Mathematics/InscribedFixedAspectRectInQuad.h

February 24, 2024. Implemented the maximum-area, fixed-aspect-ratio, axis-aligned rectangle inscribed in a convex quadrilateral. See the document [Largest Fixed-Aspect, Axis-Aligned Rectangle](#)

GTE/Mathematics/InscribedFixedAspectRectInQuad.h

February 19, 2024. Modified the code based on Lev A. Melnikovsky's mathematical formulation to avoid computing eigenvectors until needed and to avoid numerical discontinuities when computing eigenvectors.

GTE/Samples/Imagics/ExtractRidges/ExtractRidgesConsole.cpp

February 1, 2024. I had added the new files [BVTree.h](#), [BVTreeOfTriangles.h](#), and [AABBBVTreeOfTriangles.h](#) to the MSVS 2022 project and filter files. The MSVS 2019 project and filter files needed the new files added to them.

GTE/GTMathematics.v16.{vcproj,vcsproj.filters}

January 31, 2024. The GTE `LInfinityNorm` function was missing a `std::fabs` applied to `M[0]`. The GTL version of this function is correct.

GTE/Mathematics/Matrix.h

January 29, 2024. The function `operator()` was missing the test for `zOrder` being 5 or smaller. The inner-most loop had `k` bounded by 4 when it should have been 6.

[GTE/Mathematics/HermiteTriquintic.h](#)

January 20, 2024. Added abstract classes and derived class for constructing a bounding volume tree for geometric primitives. These will eventually replace the current OBB tree classes. The class `ABBBVTreeOfTriangles` was needed for a contracting project.

[GTE/Mathematics/BVTree.h](#)

[GTE/Mathematics/BVTreeOfTriangles.h](#)

[GTE/Mathematics/AABBBVTreeOfTriangles.h](#)

January 18, 2024. The finite-difference approximation to the second-order derivative $\partial^2 f(x, y)/\partial y^2$ had a typographical error. Also, to avoid sign changes artificially generated because the numerical eigensolver can be inconsistent in returning eigenvectors: At one point an eigenvector U is returned but at a nearby point an eigenvector is return that is approximately $-U$. Thanks to Lev A. Melnikovsky for reporting the problems and fixing them.

[GTE/Samples/Imagics/ExtractRidges/ExtractRidgesConsole.cpp](#)

January 7, 2024. New major version posted, no updates yet.