



# Open CASCADE Technology ver. 7.3.0 Minor Release

## Release Notes

### Overview

**Open CASCADE Technology and Products version 7.3.0** is a minor release, which includes about **350** new features, improvements and bug fixes over minor release 7.2.0.



## Highlights

### General

- ➔ Support of Unicode file names and software signals handling for MinGW-w64 builds
- ➔ Recommendations on fulfillment of LGPL terms in Overview documentation
- ➔ Restored compatibility with Visual Studio 2008
- ➔ Support of GBK and Big5 code pages

### Application Framework

- ➔ Ability to redefine the stored/retrieved document version and the application name

### Modeling

- ➔ Face Removal algorithm
- ➔ Optimized surface intersection, shape offset and Boolean operation algorithms
- ➔ Oriented Bounding Boxes (OBB)
- ➔ More complete history in the family of Boolean Operations algorithms
- ➔ Improved stability of BRepProj\_Projection algorithm

### Visualization

- ➔ Corrected translation of single-stroke fonts into BRep
- ➔ Improved compatibility with EGL on Linux, Intel HD GPUs, Mesa OpenGL, remote desktop
- ➔ Possibility to arrange more than 8 light sources and assign them to layers
- ➔ Possibility to assign Shading Model per primitive array
- ➔ Support of custom GLSL programs with Geometry and Tessellation shaders
- ➔ Distance and size culling options for rendering large scenes
- ➔ Depth pre-pass option for rendering heavy custom GLSL programs
- ➔ Verbose frame statistics for profiling 3D Viewer performance

### Data Exchange

- ➔ Documentation for PMI in XCAF



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## New Features

### Face Removal Algorithm

OCCT 7.3.0 introduces new Face Removal algorithm for 3D models. The algorithm removes features, such as holes, protrusions, gaps, chamfers, fillets, etc. from the model and fills them by extension of the faces adjacent to the feature. I.e., the feature is pulled up or down until it is completely gone (enclosed by the neighboring faces).

On the API level the algorithm is implemented in the class `BRepAlgoAPI_Defeaturing`. The actual removal of faces is performed by the low-level algorithm `BOPAlgo_RemoveFeatures`.

### Oriented Bounding Boxes

The new class `Bnd_OBB` stores the definition of an Oriented Bounding Box of a geometric entity. Since an Oriented Bounding Box is usually tighter than Axes-Aligned Bounding Box its usage allows producing more efficient algorithms of collision detection.

Two approaches are used to compute OBB of a shape. One is based on di-tetrahedron algorithm and is used for shapes containing triangulation or fully consisting of planar surfaces. Another approach is based on Principal Component Analysis algorithm and is used for all other shapes.

In Boolean operations the oriented bounded boxes are available in experimental mode and can be turned on by a special option `SetUseOBB(flag)`.

### Generated Elements after Booleans

Since OCCT 7.3.0 it is possible to obtain the elements Generated during Boolean operation - the new shapes obtained as a result of pure intersection (not overlapping) of the argument shapes. In the context of Boolean Operations the Generated shapes are always:

- Vertices created from the intersection points and may be Generated from edges and faces only;
- Edges created from the intersection curves and may be Generated from faces only.

So, only EDGES and FACES can have information about Generated shapes. For all other types of argument shapes the list of Generated shapes will be empty.

This feature has been implemented as the method `BOPAlgo_Builder::Generated`.



## Modifications

### Foundation Classes

28931	<p><i>Summary:</i> Eliminate dependency from TBB in <code>OSD_Parallel</code> header.</p> <p>Methods <code>OSD_Parallel::For()</code> and <code>ForEach()</code> have been implemented in CXX files to avoid direct dependency of client code that uses <code>OSD_Parallel</code> on TBB headers and the necessity to link with TBB explicitly.</p> <p>Runtime polymorphism (virtual methods) is used to hide implementation (TBB or threads-based).</p>
29064	<p><i>Summary:</i> Copying of empty <code>NCollection</code> map takes excessive memory.</p> <p>Resizing of <code>NCollection</code> maps is skipped in <code>Assign()</code> methods if the given map is empty.</p>
29171	<p><i>Summary:</i> C signal handler does not work on MinGW.</p> <p>Setting signal handler has been enabled in <code>OSD::SetSignal()</code> for MinGW (works only for SEH builds of MinGW, not for SJLJ builds).</p> <p>Due to the absence of function <code>_set_se_translator()</code> in MinGW, the handler is set using <code>Csignal()</code> function and thus is called asynchronously.</p> <p>Macro <code>OCC_CONVERT_SIGNALS</code> has been enabled for MinGW build to support conversion of signals to C++ exceptions using long jumps (in the same way as on Linux).</p>
29258	<p><i>Summary:</i> Provide move constructors for string classes.</p> <p>New macro <code>OCCT_NO_RVALUE_REFERENCE</code> disables methods using move semantics on obsolete compilers that do not support rvalue references.</p> <p>Method <code>Swap()</code>, move constructor, and move assignment operator have been added in classes <code>TCollection_AsciiString</code>, <code>TCollection_ExtendedString</code> and <code>NCollection_UtfString</code>.</p>
29289	<p><i>Summary:</i> Wrong derivatives in <code>math_TrigonometricFunctionRoots.cxx</code> file.</p> <p>New class <code>math_TrigonometricEquationFunction</code> has been implemented instead of <code>MyTrigoFunction</code> to provide possibilities for unit testing. Expressions for derivatives have been corrected.</p> <p>New Draw command <code>intconcon</code> provides intersection of 2d conic curves.</p>
29299 29315	<p><i>Summary:</i> <code>NCollection</code> - define explicit empty constructor for map classes.</p> <p>Ambiguous constructors have been marked with explicit keyword for classes <code>NCollection_DataMap</code>, <code>NCollection_DoubleMap</code>, <code>NCollection_IndexedDataMap</code>, <code>NCollection_IndexedMap</code>, <code>NCollection_List</code>, <code>NCollection_LocalArray</code>, <code>NCollection_Map</code>, <code>NCollection_Sequence</code>, <code>NCollection_SparseArray</code> and <code>NCollection_UBTree</code>.</p>



<p>29302</p>	<p><i>Summary:</i> <code>NCollection</code> - optimize iteration of indexed maps.</p> <p><code>NCollection_IndexedMap</code> and <code>NCollection_IndexedDataMap</code> now access Key by Index number without computing Hash code.</p> <p><code>IndexedMapNode::myNext2</code> and <code>IndexedDataMapNode::myNext2</code> fields have been removed, so that indexed map now may use less memory. <code>TCollection::NextPrimeForMap()</code> has been extended up to 2038431745 (almost full signed 32-bit integer range), and <code>NCollection_BaseMap::mySaturated</code> property has been removed.</p> <p>Duplicating checks for out of range input have been removed from <code>NCollection_IndexedDataMap::RemoveFromIndex()</code>, <code>FindKey()</code>, <code>FindFromIndex()</code> and <code>ChangeFromIndex()</code>.</p>
<p>29344</p>	<p><i>Summary:</i> <code>TCollection_AsciiString</code> - replace confusing <code>strncpy</code> with <code>memcpy</code>.</p> <p>The use of <code>strncpy</code> within <code>TCollection_AsciiString</code> has been replaced by <code>memcpy</code>, where string length has been already determined. <code>TCollection_AsciiString(const char*, int)</code> and <code>TCollection_AsciiString::SetValue()</code> have been modified to throw exception on the attempt to define invalid length of the string.</p>
<p>29349</p>	<p><i>Summary:</i> <code>OSD_Timer</code> - add missing <code>theThisThreadOnly</code> constructor option available in <code>OSD_Chronometer</code>.</p> <p><code>OSD_Timer</code> constructor now has <code>theThisThreadOnly</code> option passed to <code>OSD_Chronometer</code>, which is <code>FALSE</code> by default. <code>OSD_Chronometer</code> now provides methods <code>::UserTimeCPU()</code> and <code>::SystemTimeCPU()</code> allowing to fetch CPU times without awkward syntax through overloaded <code>::Show()</code>.</p>
<p>29355</p>	<p><i>Summary:</i> OCCT 6.9.1 persistence restored in OCCT 7.2.0 not working.</p> <p>Auxiliary classes <code>StdObjMgt_ReadData::Object</code> and <code>StdObjMgt_WriteData::Object</code> have been renamed to <code>ObjectSentry</code> (to better reflect their nature); their constructor is made explicit to ensure that such objects are always created intentionally. These objects are instantiated explicitly in the body of relevant functions, instead of implicit creation as temporary objects when function requires such object as argument.</p>
<p>29399</p>	<p><i>Summary:</i> Optimize reading of floating point values from text strings.</p> <p>Function <code>Strtod()</code> is implemented using open source (MIT-style license) code by David M. Gay instead of <code>strtod()</code> provided by standard run-time library. This improves its performance by 3-10 times.</p> <p>Functions <code>Atof()</code>, <code>Strtod()</code>, <code>Printf()</code>, <code>Sprintf()</code> and <code>Fprintf()</code> are declared as <code>extern "C"</code> to be usable from C programs. <code>Strtod()</code> is used in <code>Interface_FileReaderData::Fastof()</code> and in <code>RWStl_Reader</code> to accelerate their work.</p>
<p>29447</p>	<p><i>Summary:</i> The constructor of <code>Message_PrinterOStream</code> mixes up <code>cout</code> and <code>cerr</code>.</p> <p>Use of <code>cerr</code> or <code>cout</code> is corrected in <code>Message_PrinterOStream</code> constructor.</p>





<p>29515</p>	<p><i>Summary:</i> OSD - Spawn contains function that is not available on iOS</p> <p>Method <code>OSD_Process::Spawn()</code> has been removed as useless (not used across OCCT or products). Note that on Linux, macOS, and Windows standard C function <code>system()</code> can be used directly instead, while iOS apparently does not support spawning separate processes at all.</p>
<p>29801</p>	<p><i>Summary:</i> <code>OSD_OpenStream</code> - handle UNICODE file paths specifically in case of <code>Mingw-w64</code>.</p> <p><code>OSD_OpenStream()</code> now uses <code>__gnu_cxx::stdio_filebuf</code> extension for opening UNICODE files on <code>MingW</code> when using C++ file streams. <code>OSD_OpenStream()</code> variant accepting <code>filebuf</code> returns <code>bool</code> (true if succeeded and false otherwise).</p> <p>Checks of the stream to be opened made via calls to low-level <code>ofstream::rdbuf()</code> have been replaced by calls to <code>ofstream::is_open()</code>. The proper state of the stream is also checked.</p>

**Application Framework**

<p>26256</p>	<p><i>Summary:</i> <code>FSD_File</code> and <code>FSD_CmpFile</code> are almost twins.</p> <p><code>FSD_CmpFile</code> has become a child of <code>FSD_File</code>, avoiding code duplication.</p>
<p>29014</p>	<p><i>Summary:</i> Managing binary format versions is not possible for own <code>TDF_Attributes</code>.</p> <p><code>CDM_Application</code> has been extended to provide application name and version stored by <code>BinLDivers_DocumentStorageDriver</code>, which propagates application name and version by passing it to <code>BinMDataStd</code>.</p> <p><code>BinObjMgt_RRelocationTable</code> now stores a handle to the header data of the file to make it accessible by binary attribute drivers</p>
<p>29142 29531</p>	<p><i>Summary:</i> Exception on Redo.</p> <p>The order of attribute deltas has been fixed in <code>TDF_Data</code> to perform undo/redo operations in correct sequence.</p>
<p>29214</p>	<p><i>Summary:</i> <code>TPrsStd_AISPresentation::AISUpdate()</code> should not implicitly redraw 3D Viewer.</p> <p>Unnecessary implicit update is eliminated.</p>
<p>29220 29381</p>	<p><i>Summary:</i> Replace <code>CDM_MessageDriver</code> interface by <code>Message_Messenger</code>.</p> <p>Messenger interface <code>CDM_MessageDriver</code> has been replaced by classes from package <code>Message</code> (e.g. <code>Message_Printer</code> replaces <code>CDM_MessageDriver</code>, <code>Message_PrinterOStream</code> replaces <code>CDM_COutMessageDriver</code>).</p>
<p>29353</p>	<p><i>Summary:</i> Optimization of <code>TPrsStd_AISPresentation::SetSelectionMode()</code>.</p> <p>The method <code>TPrsStd_AISPresentation::SetSelectionMode()</code> has been optimized to avoid unconditional redisplay of the interactive object on change of selection mode.</p>



29371	<p><i>Summary:</i> The problem with the attributes constructor call.</p> <p>The default GUID is now assigned to the attribute instead of the null GUID if the attribute constructor and <code>AddAttribute</code> method are used instead of <code>Set</code> method call.</p>
29385	<p><i>Summary:</i> <code>TDataStd_IntPackedMap</code> lacks interface to set map as <code>TColStd_PackedMapOfInteger</code>.</p> <p>New method <code>ChangeMap (const TColStd_PackedMapOfInteger&amp; theMap)</code> sets map available as <code>TColStd_PackedMapOfInteger</code>.</p>
29402	<p><i>Summary:</i> In OCCT7.2.1-dev the names written into <code>FSD_File</code> are associated with wrong shapes.</p> <p>The problem with incorrect Roots indexing has been fixed by changing <code>DataMap</code> to <code>IndexedDataMap</code>.</p> <p>Draw command <code>fsdread</code> now allows restoring of shapes with preserved names.</p>
29422	<p><i>Summary:</i> Old persistence - wrong implementation of writing a reference.</p> <p><code>StdObjMgt_WriteData</code> supports the old persistent format.</p>
29443	<p><i>Summary:</i> It is not possible to store <code>ExtStringArray</code> OCAF attribute to any previous version in XML file format.</p> <p><code>XmlMDataStd_ExtStringArrayDriver</code> now allows saving to earlier XML versions.</p>
29452	<p><i>Summary:</i> Failed to read an OCAF XML document with <code>1. #QNAN</code> value.</p> <p>Method <code>XmlObjMgt::GetReal ()</code> has been improved to recognize NAN and infinity written by old MSVC runtime (like <code>1. #QNAN</code> and <code>1. #INF</code>) and detect situation when there are some trailing non-space symbols after the real value, returning <code>False</code> in such case.</p> <p>Reading of real-value attributes (single real, array, list) from OCAF XML format has been improved to create a valid attribute even if the parsing of some members fails. A warning is generated instead of error in such case.</p>
29574	<p><i>Summary:</i> Protection of attributes retrieval against zero ID in OCAF XML.</p> <p>Attributes supporting several supporting user-defined IDs have been protected against zero ID in several classes of <code>XmlMDataStd</code> package.</p>
29621	<p><i>Summary:</i> Impossible to attach existing tessellation to <code>XCAFDoc_Note</code>.</p> <p>New transfer object <code>XCAFNoteObjects_NoteObject</code> for auxiliary data contains text and attachment positions, note plane and tessellated presentation.</p> <p><code>GetObject/SetObject</code> methods have been added to <code>XCAFDoc_Note</code> attribute. The orientation of notes can be imported from XCAF.</p>



29669	<p><i>Summary:</i> Crash on opening a document with the same OCAF attributes with different IDs.</p> <p>Protection against clash of attributes with the same GUID while opening the document from a binary or XML file has been provided in the case when more than one attribute of the same type but with different GUIDs are stored on the same label.</p>
29816	<p><i>Summary:</i> Add the possibility to get/set shape presentations for GD&amp;T label through one function.</p> <p>New methods <code>GetGDTPresentations()</code> and <code>SetGDTPresentations()</code> have been added for Dimension Tool <code>XCAFDoc_DimTool</code>.</p>

**Modeling Data**

27356	<p><i>Summary:</i> <code>BRepTools::Clean()</code> does not clean free edges from <code>Poly_Polygon3D</code>.</p> <p><code>BRepTools::Clean()</code> now cleans 3D polygons on edges.</p>
29102	<p><i>Summary:</i> Missing points using <code>GCPnts_QuasiUniformDeflection</code>.</p> <p>The method <code>GCPnts_QuasiUniformDeflection::PerformCurve</code> provides proper derivative at the end of the current curve.</p> <p>Draw commands <code>crvpoints</code> and <code>crvtpoints</code> now work with wires as composite curves.</p>
29287	<p><i>Summary:</i> Move package <code>GProp</code> from <code>TKG2d</code> to <code>TKG3d</code>.</p>
29448	<p><i>Summary:</i> The method <code>Extrema_FuncExtCS::GetStateNumber</code> mixes up parameter on curve with parameter U on surface.</p> <p>The code has been corrected to avoid confusion.</p>
29775	<p><i>Summary:</i> <code>BRepAdaptor_CompCurve</code> parameterization is incorrect.</p> <p>It has been explicitly stated in <code>BRepAdaptor_CompCurve</code> that this class can only work on valid wires where all edges are connected to each other to make a chain.</p>



Modeling Algorithms

<p>22750 27683 29322</p>	<p><i>Summary:</i> Unify faces classification procedures in Boolean Operations.</p> <p>New method <code>BOPAlgoTools::ClassifyFaces()</code> provides a unified face classification procedure for methods <code>BOPAlgoBuilder::FillIn3DParts()</code> and <code>BOPAlgoBuilderSolid::PerformInternalShapes()</code>.</p> <p>BOP intersection algorithm <code>BOPAlgoPaveFiller</code> now forces intersection of edges after the tolerance values of their vertices have been enlarged.</p> <p><code>BOPAlgoTools::PerformCommonBlocks()</code> method now avoids losing faces of already created Common blocks.</p> <p>When PCurves are built for edges on faces, the validity of existing PCurves is checked for periodic surfaces and PCurves are adjusted if necessary.</p>
<p>25104 25693</p>	<p><i>Summary:</i> Prism from BSpline curve cannot be chamfered.</p> <p>Methods <code>IntCurveSurface_ComputeTransitions</code> and <code>IntTools_EdgeEdge::IsIntersection</code> have been protected against zero-length vectors.</p>
<p>25879</p>	<p><i>Summary:</i> Result of blend fails the bopcheck.</p> <p>Protection against zero-length <code>gp_Dir</code> construction has been added in method <code>ElCLib::LineParameter</code>.</p>
<p>25930 27784</p>	<p><i>Summary:</i> Thickness fails on cylinder with draft.</p> <p>Calculation of intersection in 2D space has been corrected in class <code>BRepOffset_Tool</code>.</p>
<p>25609 29532</p>	<p><i>Summary:</i> Clean up the duplicate classes in TKBO project.</p> <p>Collection classes from <code>BOPCol</code> package have been replaced by classes from <code>TopTools</code> and <code>TColStd</code> packages or removed. Additionally:</p> <ul style="list-style-type: none"> <li>▪ The class <code>BOPDS_PassKey</code> and its containers have been removed as unused;</li> <li>▪ The containers <code>IntTools_DataMapOfShapeAddress</code> and <code>IntTools_IndexedDataMapOfTransientAddress</code> have been removed as unused;</li> <li>▪ The container <code>Bitgtc_DataMapOfShapeBox</code> is replaced with <code>TopTools_DataMapOfShapeBox</code>;</li> <li>▪ The class <code>BOPTools</code> has been removed as a duplicate of the class <code>TopExp</code>.</li> </ul>
<p>26493 28599 29426 29746</p>	<p><i>Summary:</i> Replacement of old Boolean operations with new ones in <code>BRepProj_Projection</code> algorithm.</p> <p>The use of <code>BRepAlgoSection</code> has been replaced with <code>BRepAlgoAPI_Section</code> in <code>BRepProj_Projection</code> algorithm. The performance of <code>BRepAlgoAPI_Section</code> has been improved.</p> <p>The API classes from package <code>BRepAlgo</code> that provide access to old Boolean operations are marked as deprecated. The corresponding classes from package <code>BRepAlgoAPI</code> should be used instead.</p>



<p>26570</p>	<p><i>Summary:</i> Crash on attempt to rotate a shape.</p> <p>Draw-command <code>trotate</code> (<code>ttranslate</code>, <code>tmirror...</code>) has been extended by additional parameter - copy.</p> <p>New check of edge range has been added in <code>BRepCheck</code>, <code>BRepCheck_Edge</code> and <code>ShapeAnalysis_Edge</code>.</p> <p><code>BRepTools_TrnsfModification::NewCurve2d()</code> and <code>GeomLib::SameRange()</code> have been modified to avoid exception in <code>TrimmedCurve</code>.</p>
<p>26677 28211 28377</p>	<p><i>Summary:</i> Boolean fuse operation produces incorrect result.</p> <p>The procedure of initialization of <code>BRepTopAdaptor_FClass2d</code> and <code>IntTools_FClass2d</code> classifiers has been corrected to produce a tighter polygon in case of self-intersections on very thin faces.</p>
<p>26789 26883 27948 29580 29646</p>	<p><i>Summary:</i> invalid result of BOP Fuse.</p> <p>Solid Builder algorithm (<code>BOPAI go_BuilderSolid</code>) now avoids creation of INTERNAL solids from unclassified faces.</p> <p>Instead the user is warned that some of the faces have been unclassified and not used for solids creation.</p>
<p>28102</p>	<p><i>Summary:</i> Problem cutting a plate with several holes (670).</p> <p><code>IntPatch_ImpPrmIntersection</code> algorithm now correctly processes cases when the point of Walking-line splitting is near to the boundary of the intersection domain but does not match this boundary.</p>
<p>28150 28763</p>	<p><i>Summary:</i> Exception is raised during Boolean operation</p> <p>Method <code>ProjLib_ComputeApproxOnPol arSurface::BuildInitial Curve2d(...)</code> now uses a correct number of points.</p>
<p>28245</p>	<p><i>Summary:</i> Result of Cells Builder algorithm becomes invalid after removal of internal boundaries on faces.</p> <p><code>BOPAI go_CellsBuilder</code> has been corrected to remove internal boundaries between faces of the same material at once for the whole shape, while preserving the boundaries between areas with different materials.</p>
<p>28248</p>	<p><i>Summary:</i> HLR algorithm result is retrieved from the last added shape only.</p> <p>Mistakes in retrieving of <code>HLRBRep_EdgeData</code> by value instead of reference have been corrected.</p>
<p>28385</p>	<p><i>Summary:</i> Improve drawing isolines (<code>DBRep_IsoBuilder</code> algorithm).</p> <p>The algorithm <code>DBRep_IsoBuilder</code> computing the iso-lines on face for display in DRAW viewer now avoids iso-lines going out of face.</p> <p>Additional <code>Init()</code> method has been implemented for <code>WireExplorer</code> algorithm. It takes UV bounds of the face to avoid their repeated computation when a face with multiple wires is processed.</p>



<p>28485 29237 29293</p>	<p><i>Summary:</i> Improve performance of Boolean Operations.</p> <p>The following improvements have been introduced to increase performance of Boolean Operations on relatively fast cases:</p> <ul style="list-style-type: none"> <li>▪ <b>FaceInfo</b> information is initialized for the faces participating in Face/Face interference even when the gluing is ON to take into account intersection of their sub-shapes.</li> <li>▪ Methods <b>BOPAI go_ShellSplitter::MakeConnexityBlocks</b> and <b>BOPAI go_WireSplitter::MakeConnexityBlocks</b> have been unified into <b>BOPTools_AlgoTools::MakeConnexityBlocks</b>.</li> <li>▪ Unnecessary bounding box computation is avoided for solids during DS initialization. The bounding boxes for solids will be computed during the building stage to find faces located inside solids. For the shape self-interference check (performed by the <b>BOPAI go_CheckerSI</b>), the bounding box is still computed, as it is necessary to resolve Shape/Solid intersections.</li> <li>▪ Only three sample points are used to check coincidence of line and plane.</li> <li>▪ Planes intersection is performed only when the gluing is off.</li> <li>▪ Repeated initialization of 2D classifier while building splits of the faces is avoided.</li> <li>▪ Methods <b>CorrectWires</b> and <b>CheckEdge</b> save data to avoid its recalculation.</li> <li>▪ It is possible to disable the classification of the input solids on the inverted status (to be the holes in the space).</li> <li>▪ Building of bounding boxes for faces/solids during splitting of the input arguments for their classification into hole faces/shells is avoided if no holes are created.</li> <li>▪ Rebuilding of the faces/solids from arguments which does not acquire any inside parts of other arguments is avoided by using their draft versions as their splits.</li> </ul>
<p>28499 28722</p>	<p><i>Summary:</i> Conversion of a spherical face to a spline produces an invalid shape.</p> <p>2D tolerance calculation for BSpline/Bezier surfaces has been improved in <b>BRepCheck_Wire</b> class.</p>
<p>28557 28984 29323</p>	<p><i>Summary:</i> Intersection algorithm produces the curve with oscillation.</p> <p>The algorithm <b>IntPatch_WalkingLineTool</b> purging extra points from the walking line now avoids making too large distance between two neighbor segments of the line.</p>
<p>28764</p>	<p><i>Summary:</i> Intersection of faces gives exception in debug mode.</p> <p>New method <b>IntWalk_Pwalking::RemoveAPoint()</b> provides safe removal of points from the Walking-line.</p>
<p>28886</p>	<p><i>Summary:</i> Infinite loop at intersecting two faces / surfaces.</p> <p><b>IntWalk_Pwalking</b> has been fixed to avoid constantly increasing/decreasing steps.</p>
<p>28903</p>	<p><i>Summary:</i> <b>BRepOffset_MakeOffset</b> produces invalid shape (<b>thickshell</b>) in Intersection mode.</p> <ul style="list-style-type: none"> <li>▪ Method <b>BRepOffset_Tool::Inter3D</b> is now used for selection of proper edges. They are not concatenated into one edge if they pass through a vertex on boundary.</li> <li>▪ Selection of edges has been eliminated in method <b>BRepOffset_Inter3d::ConnexIntByInt</b> because now this method is able to process seam edges correctly.</li> </ul>



<p>28909 29183</p>	<p><i>Summary:</i> BO algorithm is stuck while fusing shell and edges.</p> <p>Approximation parameters: <code>degmin</code>, <code>degmax</code>, max number of segments, boundary condition and maximal projection distance have been added in the interface of classes <code>ProjLib_ProjectedCurve</code>, <code>ProjLib_ComputeApprox</code> and <code>ProjLib_ComputeApproxOnPol arSurface</code>.</p> <p><code>Approx/Approx_ComputeCLi ne</code> algorithm now can treat the maximal number of segments allowed for cutting.</p> <p>Method <code>BOTools_Al goTools2D: : MakePCurveOnFace(...)</code> now manages cases with big edge tolerances.</p>
<p>28982</p>	<p><i>Summary:</i> 2D offset creates faulty result from wire.</p> <p><code>IntTools_EdgeEdge</code> intersection algorithm has been protected from incomplete type conversion caused by presence of Trimmed curves by using Adaptors providing typed curves instead of direct casting.</p>
<p>29038</p>	<p><i>Summary:</i> <code>IntTools_EdgeEdge: : Fi ndParameters()</code> hangs on bad curve.</p> <p>The possibility to dramatically increase the step during iteration on curve when the global resolution of the curve is too small has been added in functions <code>Fi ndParameters</code>, <code>Fi ndBestSol uti on</code> and <code>Fi ndDi stPC</code>.</p>
<p>29073 29103</p>	<p><i>Summary:</i> General Cut produces invalid shape.</p> <p>The reporting system of Boolean operations provides new warnings:</p> <ul style="list-style-type: none"> <li>▪ <code>BOPAl go_Al ertIntersecti onOfPai rOfShapesFai led</code> when the intersection of pair of sub-shapes of the arguments has failed;</li> <li>▪ <code>BOPAl go_Al ertBui ldi ngPCurveFai led</code> when the building of the 2D curve of the edge on face has failed;</li> <li>▪ <code>BOPAl go_Al ertAcqui redSel fIntersecti on</code> when the positioning and tolerances of the arguments lead to creation of self-interfered shapes.</li> </ul> <p>These warnings allow completing the operation even if some sub-shapes do not intersect or some PCurves are not built. They also give pairs of sub-shapes, on which the intersection/projection has failed, providing the ability to analyze the intersection results.</p>
<p>29099</p>	<p><i>Summary:</i> Extra shapes in result of General Cut (box by ellipsoid).</p> <p>Search for splitting parameters on degenerated edges has been improved in <code>BOPAl go_PaveFi ller</code> algorithm.</p>
<p>29126 29179 29180</p>	<p><i>Summary:</i> Result of Boolean common depends on the order of arguments.</p> <p>Usage of <code>Bnd_Box</code>-filtering has been eliminated while putting a (definitely) common vertex between two faces on the intersection curve.</p>
<p>29135</p>	<p><i>Summary:</i> 3D Offset algorithm produces a NULL shape.</p> <p><code>UpdateVal i dEdges</code> function from <code>BRepOffset_MakeOffset_1</code> filters splits of the edges in two stages:</p> <ul style="list-style-type: none"> <li>▪ Filters the connected blocks separately using localized bounding edges taken only from the splits of offset faces from the block;</li> <li>▪ Provides combined treatment of the remaining splits using bounding edges from the splits of all offset faces.</li> </ul>



29157	<p><i>Summary:</i> Suspicious pass-through of case labels in switch statements.</p> <p>Suspicious passes through case labels have been resolved by using <code>Standard_FALLTHROUGH</code> macro or by redesigning the code.</p>
29159	<p><i>Summary:</i> Sewing fails when using a maximum tolerance.</p> <p><code>BRepBuilderAPI_Sewing</code> now uses the truly computed edge tolerance if the tolerance imposed by <code>BRepLib::SameParameter</code> is too large.</p>
29162 29175	<p><i>Summary:</i> <code>Geom2dInt_GIntEr</code> algorithm does not find intersection of ellipse and line</p> <p>Analytical intersection algorithm has been implemented for ellipse-line intersection in <code>IntCurve_IntConicConic</code> class.</p>
29182	<p><i>Summary:</i> <code>BOPAlgo_PaveFiller</code> sometimes raises exception in parallel mode.</p> <p>Data races are now avoided in <code>BOPAlgo_PaveFiller</code>:</p> <ul style="list-style-type: none"> <li>▪ Only unique edge-face pairs are processed.</li> <li>▪ A copy of the edge is made in each thread and updated if the same edge is treated simultaneously with different faces in different threads. The original edge is updated only when parallel processing is finished.</li> </ul> <p>New method <code>BOPTools_AlgoTools::CopyEdge</code> copies edge with vertices.</p>
29186	<p><i>Summary:</i> Move <code>AddTool()</code>, <code>SetTools()</code>, <code>Tools()</code> and other common methods of BOP tools to a separate interface class.</p> <p>New <code>BOPAlgo_ToolsProvider</code> class with methods <code>AddTool()</code>, <code>SetTools()</code> and <code>Tools()</code> has been added.</p> <p><code>BOPAlgo_BOP</code> and <code>BOPAlgo_Splitter</code> are now successors of <code>BOPAlgo_ToolsProvider</code>.</p>
29188	<p><i>Summary:</i> Null shape is produced by 3D offset algorithm (mode="Complete", Join Type="Intersection").</p> <p>The following improvements have been made in the 3D offset algorithm for mode "Complete" and Join type "Intersection":</p> <ul style="list-style-type: none"> <li>▪ <code>RemoveInsideFaces()</code> removes the invalid parts outside of the solids built from the splits of offset faces. It helps to avoid their rebuilding and to speed up the computation.</li> <li>▪ <code>FindVerticesToAvoid()</code> strengthens the criteria for the vertices to be avoided in the new splits.</li> </ul>
29204	<p><i>Summary:</i> <code>BRepOffsetAPI_MakePipeShell</code> produces invalid result and raises exception in Draw.</p> <p><code>ChooseSection</code> algorithm searching for section in the corner is now able to find simple cases with rather big tolerance.</p> <p>The constructor of <code>BRepFill_Section</code> now removes locations in the section shape as it is done in <code>BRepFill_Pipe</code>.</p> <p>Correction of U-edges by <code>Same Parameter</code> has been added to the method <code>BRepFill_Sweep::Build</code>.</p>



<p>29234 29627</p>	<p><i>Summary:</i> <b>BRepOffsetAPI_NormalProjection</b> produces <b>INTERNAL</b> edges and vertices</p> <ul style="list-style-type: none"> <li>▪ The algorithm <b>BRepOffsetAPI_NormalProjection</b> uses section operation instead of common to get the edge-result of projection within face restrictions.</li> <li>▪ The algorithm <b>ShapeUpgrade_UnifySameDomain</b> now correctly gathers same domain faces in a compound.</li> <li>▪ The script <b>snowflake.tcl</b> does not depend on the order of edges in the result.</li> </ul>
<p>29301</p>	<p><i>Summary:</i> Improve performance of Boolean Operations.</p> <p>Performance of Boolean operations algorithm has been improved by:</p> <ul style="list-style-type: none"> <li>▪ Improving the check of Same Domain faces in <b>BOPAlgo_Builder::FillSameDomainFaces()</b>;</li> <li>▪ Faster rejection of outer faces for solids using Bounding Box classification first in <b>BOPAlgo_Builder::FillIn3Dparts()</b>;</li> <li>▪ Using <b>IncAllocator</b> for local containers.</li> <li>▪ Method <b>BOPAlgo_PaveFiller::IsExistingPaveBlock()</b> provides correct edge tolerance.</li> <li>▪ Method <b>PutClosingPaveOnCurve()</b> now uses the tolerance of the pave put on the bound to check curve for closeness and valid range (to avoid considering small curves (within vertex tolerance) closed).</li> </ul>
<p>29311 29312</p>	<p><i>Summary:</i> Using OBB to speed up Boolean Operations.</p> <p>The Oriented Bounding Boxes (OBB), are the bounding volumes enclosing shapes in the same way as the Axes-Aligned Bounding Boxes (AABB). Generally, the OBB should be much tighter than AABB, thus can be used more effectively for fast rejection of non-interfering objects. The OBB objects have been implemented in OCCT and integrated into modeling algorithms as a new class <b>Bnd_OBB</b>.</p> <p>By default the usage of OBB is turned off. It is enabled by the method <b>SetUseOBB(flag)</b> available for all operations in Boolean Component.</p> <p>In Draw the command <b>buseobb 0/1</b> should be used. Note, that this will affect all subsequent operations.</p> <p>The OBB for shapes are built by the first necessity and stored into operation context <b>IntTools_Context</b>.</p>
<p>29321</p>	<p><i>Summary:</i> Improve performance of 3D offset algorithm for the planar cases.</p> <p>Intersection of offset face splits in "Complete" mode is now performed by the dedicated method <b>BuildShellCompleteInter()</b>.</p>
<p>29333</p>	<p><i>Summary:</i> Prevent modification of the input shapes in case their sub-shapes have not been modified.</p> <p>The following changes have been introduced to prevent modification of input shapes in destructive mode if their sub-shapes have not been modified:</p> <ul style="list-style-type: none"> <li>▪ In <b>BOPAlgo_PaveFiller::MakeSplitEdges</b>, edge splitting for pave blocks with old vertices is avoided if it is possible to use the existing edge.</li> <li>▪ In <b>BOPAlgo_Builder::FillImagesContainer</b> new containers (WIRES/SHELLS/COMPSOLIDS) are not created if no parts have been modified;</li> <li>▪ In <b>BOPAlgo_Builder::FillImagesFaces</b>, a new face is not created if no wires have been modified;</li> <li>▪ In <b>BOPAlgo_Builder::FillSameDomainFaces</b>, the original face is used as a representative for the group of SD faces, if possible.</li> </ul>



29351	<p><i>Summary:</i> Boolean Operations create invalid PCurves.</p> <p><b>BOPTools_AlgoTools2D</b> algorithm now checks if the produced 2D curve has the same range as 3D curve of the edge when it makes a PCurve for an edge on face.</p>
29356	<p><i>Summary:</i> <b>GCPnts_TangentialDeflection</b> hangs on specific curve.</p> <p>While UV Iso parameters are obtained in <b>StdPrs_IsoLines</b>, UV limits should be applied only if face bounds have infinite values. Method <b>StdPrs_IsoLines::UVIsoParameters</b> has been fixed to get correct Iso lines without modification of UV limits.</p>
29358	<p><i>Summary:</i> <b>Unifysamedomain</b> is unable to merge faces with the same underlying surface.</p> <p>The description of <b>Unifysamedomain</b> algorithm has been updated to avoid misunderstanding of its behavior.</p>
29359	<p><i>Summary:</i> Approximation algorithm computes multidimensional distance in Euclidean space incorrectly.</p> <p>Wrong distance computation in case of <b>Approx_ChordLength</b> approximation type has been corrected.</p>
29363	<p><i>Summary:</i> No history for shapes which were produced as a result of intersection.</p> <p>The method <b>Generated</b> has been implemented for the algorithms in Boolean Component. A shape can be <b>Generated</b> only if it is a result of pure intersection (not overlapping) of argument shapes. Thus, the <b>Generated</b> shapes are:</p> <ul style="list-style-type: none"> <li>▪ <b>VERTICES</b> created from the intersection points and generated from edges and faces only;</li> <li>▪ <b>EDGES</b> created from the intersection edges and generated from faces only.</li> </ul> <p>Thus only <b>EDGES</b> and <b>FACES</b> can contain <b>Generated</b> shapes. For all other types of shapes the list of <b>Generated</b> shapes will be empty.</p> <p>Methods <b>Modified</b> and <b>IsDeleted</b> have been optimized and simplified based on the correct filling of <b>BOPAlgo_BuilderShape::myImagesResult</b> map.</p> <p>The history of solids unification is provided by the <b>CellBuilder</b> algorithm.</p> <p>The User guide on Boolean Operations has been updated with new chapter "History Information" describing the rules for filling history for operations in Boolean Component.</p>
29368	<p><i>Summary:</i> Incorrect intersection state of the intersection point of two 2d curves.</p> <p>The algorithm <b>math_FunctionRoots</b> now uses two methods to find the function extremum (via the zero value of the derivative function and using the old approach), then it chooses the best of two solutions computed by different methods.</p>
29387	<p><i>Summary:</i> Incorrect result of cutting a face with several shapes.</p> <p>Section edges without valid range are now removed by <b>BOPAlgo_PaveFiller</b> algorithm.</p>



29400	<p><i>Summary:</i> Fuse of two edges creates self-interfered shape.</p> <p>Method <code>BOPAI go_PaveFiller::SplitPaveBlock</code> avoids creation of edges with too small valid range (which hinders splitting the edge) and interfering vertices.</p>
29430	<p><i>Summary:</i> Curve evaluation at boundary point.</p> <p>Previously <code>BRepAdaptor_CompCurve</code> considered the input wire to be periodic with period <code>LastParameter() - FirstParameter()</code> if it contained a single periodic edge. Now method <code>IsPeriodic</code> always returns FALSE because it is impossible to obtain correspondence between the members of <code>BRepAdaptor_CompCurve</code> class and its periodicity status.</p>
29463	<p><i>Summary:</i> Method <code>BndBox::IsOut()</code> returns true for point lying on the planar face.</p> <p>The method <code>BRepBndLib::Add</code> now enlarges the bounding box by the tolerance of edges whose curves participate in the calculation of the box.</p>
29465	<p><i>Summary:</i> <code>Extrema_ExtCC</code> returns <code>IsParallel</code> equal to true for not parallel curves.</p> <p>To decide that the curves are parallel it is additionally checked in <code>Extrema_GenExtCC</code> if their ends do not diverge.</p>
29473	<p><i>Summary:</i> DRAW command <code>spl i tshape</code> produces invalid result on the cylindrical face.</p> <p>The distance between edges in UV space is now taken into account for periodical surfaces in method <code>LocOpe_Spl i tShape::Choi xUV</code>.</p>
29481	<p><i>Summary:</i> Implementation of Face Removal algorithm.</p> <p>Face Removal algorithm removes unwanted holes, protrusions, gaps, chamfers, fillets, etc. from a 3D model consisting of solids. The algorithm removes all requested features from the shape and builds the new shape as a result. The input model is not modified.</p> <p>On the API level the algorithm is implemented in the class <code>BRepAI goAPI_Defeaturing</code>. The actual removal of faces is performed by the low-level algorithm <code>BOPAI go_RemoveFeatures</code>.</p> <p>The following changes have been made in the algorithms used by Face Removal:</p> <ul style="list-style-type: none"> <li>▪ History support for the solids is provided in <code>ShapeUpgrade_Uni fySameDomain</code>;</li> <li>▪ It is possible to merge History of any Algorithm with standard history methods, such as <code>IsDeleted()</code>, <code>Modified()</code> and <code>Generated()</code> into <code>BRepTools_Hi story</code>.</li> </ul>
29484	<p><i>Summary:</i> Avoid inheritance of the <code>BRepAI goAPI_Check</code> from <code>BRepBui l derAPI_MakeShape</code>.</p> <p><code>BRepAI goAPI_Check</code> class is inherited from <code>BOPAI go_Options</code> instead of <code>BRepAI goAPI_AI go</code>, as the latter is too excessive for checking purposes.</p> <p>Draw command <code>bopapi check</code> has been added for testing the <code>BRepAI goAPI_Check</code> algorithm.</p>



29488	<p><i>Summary:</i> Boolean operation "general fuse" creates a solid containing 5 not connected shells lying on the same level.</p> <p>Method <code>BOPTools_AlgoTools::AreFacesSameDomain</code> takes into account possible deviation of edges from the surface faces when checking two faces with the same bounds on Same Domain.</p>
29494	<p><i>Summary:</i> Intersection line between two parametric surfaces is restricted incorrectly if it matches the surface boundary.</p> <p>Creation of <code>IntPatch_Points</code> is now forbidden in tangent zones except for domain boundaries of the intersected surface.</p>
29496	<p><i>Summary:</i> No intersection curve between faces if starting points are given.</p> <p>Bounded <code>IntPatch_Points</code> are now found in case when starting points are used in intersection algorithm. Before the fix, these points were not looked for.</p>
29502	<p><i>Summary:</i> Improve performance of <code>ShapeUpgrade_UnifySameDomain::UnifyEdges()</code> method.</p> <p>The method <code>ShapeUpgrade_UnifySameDomain::UnifyEdges()</code> has been fixed to avoid repeated merging of the same chains of edges by processing all edges at once.</p>
29524	<p><i>Summary:</i> access violation in <code>HLRBRRep_PolyAlgo</code> while computing HLR for triangulation-only surface.</p> <p><code>HLRBRRep_PolyAlgo</code> has been protected against NULL dereference.</p>
29535	<p><i>Summary:</i> <code>BRepExtrema_DistShapeShape</code> returns only one solution but the wires have two intersections.</p> <p>The algorithm <code>GenExtCC</code> subdivides long curves into parts if their length is too different.</p>
29591	<p><i>Summary:</i> Improvements in the class <code>BRepOffset_Tool</code>.</p> <ul style="list-style-type: none"> <li>▪ New flag <code>ExtensionMode</code> from method <code>BRepOffset_Tool::EnlargeFace</code> defines the surface extension mode of the face. The old behavior remains the default one.</li> <li>▪ Wrong building of extended face on a closed surface. Now, if the face is closed in U-direction (like a cylinder) but the seam edge is shifted from 0 position, the resulting extended face has a properly connected seam edge.</li> <li>▪ New public static method <code>BRepTools::DetectClosedness()</code> checks whether a face is closed in U and V directions.</li> </ul>
29606	<p><i>Summary:</i> <code>BRepClass3d_SolidClassifier</code> classifies the point as IN while it is ON.</p> <p>The algorithms of curve/face and curve/surface intersection (<code>IntCurvesFace_Intersection</code> and <code>IntCurveSurface_Intersection</code>) now process simpler some analytical cases when a curve is parallel or belongs to a surface.</p>
29611	<p><i>Summary:</i> Misprint in the formula of Hessian computation in file <code>GeomLib_CheckCurveOnSurface.cxx</code>.</p>



<p>29655</p>	<p><i>Summary:</i> Distance between a cylinder and a straight line.</p> <p>In <code>Extrema_ExtCS::Perform</code> the line is trimmed by corner points of surface bounding box to reduce its range.</p>
<p>29660</p>	<p><i>Summary:</i> Misprint in <code>BUILDEdge(...)</code> static function of <code>BRepFill_Sweep.cxx</code> file.</p>
<p>29663</p>	<p><i>Summary:</i> Exception in <code>BRepFill_PipeShell</code> algorithm.</p> <p><code>BRepFill_Sweep</code> algorithm is improved to handle cases when generated revolution surface has degenerated point in the middle.</p>
<p>29682</p>	<p><i>Summary:</i> Boolean intersection with fuzzy-option hangs.</p> <p>The algorithm of step re-computation has been improved for the case of two faces intersected by their boundaries.</p>
<p>29688 29698</p>	<p><i>Summary:</i> Wrong result of CUT operation.</p> <p>New function <code>HasMultiConnected</code> from <code>BOPAlgoBulder</code> checks if the edge has multi-connected vertices. It can be used to check if the face split by the intersections with other arguments can be split by a vertex. In this case simple face reconstruction is avoided and <code>BulderFace</code> algorithm is used to split the face.</p> <p>When it is checked, if the split edge is oriented as the original one in <code>BOPTools_AlgoTools::IsSplitToReverse()</code>, the tangent vectors are computed for both edges at the same point. This point is taken on the split edge and projected on the original edge. It has been ensured that the reference point is taken inside the valid range of the split edge (i.e. not covered by the tolerance spheres of its bounding vertices) and can be successfully projected on the original edge. Moreover, several sampling points are now taken on the split edge and processed until the first valid point is found.</p> <p>If requested, (by a non-null pointer) all <code>BOPTools_AlgoTools::IsSplitToReverse()</code> methods are now return the error status of the check. Before using the returned flag, the calling program should check this error status. For a successful check the error status should be equal to zero.</p> <p>New warning <code>BOPAlgo_AlertUnableToOrientTheShape</code> is now returned in Boolean algorithms if the check for correct shape orientation has failed.</p>
<p>29701</p>	<p><i>Summary:</i> <code>BRepTools::Update(Face)</code> unexpectedly updates UV points of PCurve.</p> <p>The method <code>BRepTools::UpdateFaceUVPoints</code> has been modified to reset the UV points of the edge to the bounding points of the parametric curve of the edge on the face.</p>



Shape Healing

<p>28467</p>	<p><i>Summary:</i> Improve <code>UnifySameDomain</code> performance.</p> <p>Some not needed modes of fix are now turned off in the called <code>ShapeFix_Face</code> algorithm.</p> <p>PCurves are stored on planes in the edges to avoid repeated computation of the same PCurves many times (it is done only when <code>SafeInputMode</code> is false).</p> <p>Unnecessary replace/apply actions in the modification context are avoided.</p> <p>New command <code>buildpcurvesonplane</code> builds and stores PCurves of edges on planar faces. This is useful for investigation how the presence of PCurves on planes influences the performance of algorithms.</p> <p>The drawing of dimension line in snowflake test has become independent on the order of vertices in the result.</p>
<p>28681 29544</p>	<p><i>Summary:</i> <code>UnifySameDomain</code> distorts face boundary when it merges a chain of small linear edges.</p> <p>The function <code>GetLineEdgePoints</code> now takes into account linear tolerance value in case of a sequence of edges based on lines (which are unified into one line-segment).</p>
<p>29695</p>	<p><i>Summary:</i> Infinite loop in <code>ShapeFix_IntersectionTool</code>.</p> <p>Splitting of a wrong edge is avoided in <code>ShapeFix_IntersectionTool</code>. Protection has been added for the case when the index of the edge to be split is out of range.</p>



Visualization

22048	<p><i>Summary:</i> AIS_InteractiveContext – single object selection should always clear multiple selection.</p> <p>AIS_InteractiveContext::Select() now clears multiple selection when selecting a single object.</p>
26127	<p><i>Summary:</i> Default camera is not copied in copy constructor of V3d_View.</p> <p>V3d_View copy constructor now copies DefaultCamera() from the specified View. New argument –cloneActive has been added in Draw command view.</p>
27618	<p><i>Summary:</i> Selection returns entity overlapped by another entity on border cases.</p> <ul style="list-style-type: none"> <li>▪ Tolerance is scaled according to Camera definition in SelectMgr_ViewerSelector::updatePoint3d().</li> <li>▪ gp::Resolution() is used instead of Precision::Confusion() in SelectMgr_RectangularFrustum::segmentSegmentDistance().</li> </ul>
27732	<p><i>Summary:</i> AIS_ConnectedInteractive crashes on NULL handle returned by MeshVS_CommonSensitiveEntity::GetConnected().</p> <p>NULL-check in AIS_ConnectedInteractive::ComputeSelection() as well as interface methods MeshVS_Mesh::AcceptDisplayMode() and MeshVS_CommonSensitiveEntity::GetConnected() have been added.</p>
28069 29097	<p><i>Summary:</i> Allow picking Graphi c3d_TypeOfShadingModel per-object</p> <p>It has become possible to define shading model on per-object level. For this:</p> <ul style="list-style-type: none"> <li>▪ Graphi c3d_AspectFillArea3d has been extended by new property ::ShadingModel(), which is set to Graphi c3d_TOSM_DEFAULT by default. The new API allows assigning Shading Model to specific Primitive Array groups instead of the entire Viewer, which was the only possibility before.</li> <li>▪ Graphi c3d_TypeOfShadingModel has been extended with Graphi c3d_TOSM_DEFAULT value meaning that Shading Model defined as default for the Viewer should be used. Graphi c3d_TOSM_NONE has been renamed to Graphi c3d_TOSM_UNLIT.</li> <li>▪ V3d_TypeOfShadingModel enumeration has been merged into Graphi c3d_TypeOfShadingModel avoiding duplicated definitions and confusion. Old values remain for compatibility with old code and can be marked deprecated in the future.</li> <li>▪ Draw Harness command vaspects has been extended by new argument –setShadingModel for testing Shading Models assigned to entire objects.</li> <li>▪ OpenGL_SetOfShaderPrograms now holds an array of Shading Models. OpenGL_ShaderManager interface has been modified and now requires enumeration as input in several places where Boolean flags have been used previously (methods ::BindFaceProgram(), ::BindLineProgram() and ::BindMarkerProgram()).</li> <li>▪ OpenGL_Workspace now defines default OpenGL_AspectFace as Graphi c3d_TOSM_UNLIT to simplify indication of primitive groups with undefined Fill Area aspects. Graphi c3d_TOSM_UNLIT set as default Shading Model avoids artifacts on Lines and Markers.</li> <li>▪ Missing initialization about Fill Area aspects has been added in AIS_Manipulator::Axis::Compute().</li> </ul>





<p>27869</p>	<p><i>Summary:</i> AIS_ConnectedInteractive does not support exact HLR mode.</p> <p>AIS_ConnectedInteractive now shares HLR computation code with AIS_Shape. BRepTools_WireExplorer::Orientati on() returns TopAbs_FORWARD instead of throwing exception in case of infinite Edge without vertices.</p> <p>StdSelect_BRepSelecti onTool::GetSensi ti veForFace() creates Select3D_Sensi ti veCurve from 2 points in case of infinite Edge instead of Select3D_Sensi ti veFace.</p>
<p>28416</p>	<p><i>Summary:</i> SelectMgr_Selecti onManager::Acti vate() should not implicitly deactivate Global Selection Mode.</p> <p>Implicit deactivation of global selection mode has been removed from SelectMgr_Selecti onManager::Acti vate().</p> <p>New method AIS_InteractiveContext::SetSelecti onModeActi ve() replaces AIS_InteractiveContext::Acti vate()/::Deacti vate(). This method takes an argument AIS_Selecti onModesConcurrency, which defines what to do with already activated selection modes:</p> <ul style="list-style-type: none"> <li>▪ AIS_Selecti onModesConcurrency_Si ngle: only one selection mode can be activated at the same moment – previously activated ones should be deactivated;</li> <li>▪ AIS_Selecti onModesConcurrency_Gl obal OrLocal: either Global (AIS_InteractiveObj ect::Gl obal Selecti onMode()) or Local (multiple) selection modes can be active at the same moment;</li> <li>▪ AIS_Selecti onModesConcurrency_Mul ti ple: any combination of selection modes can be activated.</li> </ul>
<p>28760</p>	<p><i>Summary:</i> TKOpenGL – avoid excessive frustum culling traverse within extra OIT rendering pass.</p> <p>Culling traverse is no more called implicitly within OpenGL_Layer::Render(). Instead, all layers are traversed at once within OpenGL_Vi ew::render() beforehand. OpenGL_BVHTreeSelector methods have been renamed to better reflect their meaning.</p> <p>Non-persistent culling options have been moved to the dedicated structure OpenGL_BVHTreeSelector::Cull ingContext so that OpenGL_BVHTreeSelector instance can be used for different Layers without modifying its state.</p>
<p>28987 28988 29779</p>	<p><i>Summary:</i> SelectMgr_Selectabl eObj ect – move out iterator from object.</p> <p>SelectMgr_Selectabl eObj ect now provides access to the list of selections using external Iterator objects. For this:</p> <ul style="list-style-type: none"> <li>▪ New method SelectMgr_Selectabl eObj ect::Selecti ons() replaces deprecated methods Ini t(), More(), Next() and CurrentSelecti on().</li> <li>▪ New method SelectMgr_Selecti on::Entiti es() replaces deprecated methods Ini t(), More(), Next() and Sensi ti vi ty().</li> <li>▪ SelectMgr_Selectabl eObj ect::myAssembl yOwner has been moved to AIS_Mul ti pleConnec tedI nteracti ve.</li> <li>▪ SelectMgr_Selectabl eObj ect::Selecti on() now returns NULL handle for not found selection.</li> </ul>



<p>28987 28988 29779</p>	<ul style="list-style-type: none"> <li>▪ <code>SelectMgr_SelectableObject::HasSelection()</code> is no more virtual and just returns <code>!Selection().IsNull()</code>.</li> <li>▪ <code>SelectMgr_SelectionManager::mySelectors</code> map is now declared using proper key type <code>Handle(SelectMgr_ViewerSelector)</code> instead of <code>Handle(Standard_Transient)</code>.</li> <li>▪ Broken <code>HasTransformation()</code> checks have been removed from <code>SelectMgr_SelectableObject</code> and <code>SelectMgr_SelectionManager</code>.</li> </ul>
<p>29062</p>	<p><i>Summary:</i> <code>SelectMgr_ViewerSelector</code> – add NULL-check within <code>::checkOverlap()</code> method.</p>
<p>29074</p>	<p><i>Summary:</i> <code>TKOpenGL</code> – support Geometry Shader definition.</p> <p><code>Graphi c3d_TypeOfShaderObject</code> enumeration has been extended by Geometry shader object type.</p> <ul style="list-style-type: none"> <li>▪ <code>OpenGL_ShaderProgram::Initialize()</code> processes new shader object types when supported by OpenGL version.</li> <li>▪ <code>Declarations.glsl</code> has been fixed so that <code>occFragColor</code> is defined only for Fragment Shader object (by handling new <code>FRAGMENT_SHADER</code> macros).</li> <li>▪ Draw command <code>vshader</code> has been extended to support definition of Shader Object types other than Vertex and Fragment shader.</li> </ul>
<p>29084</p>	<p><i>Summary:</i> <code>AIS_Manipulator</code> – broken transformation is applied at Rotation angles near to Pi.</p> <p>Use of manipulator axes with temporarily applied transformation (when <code>BehaviorOnTransform::FollowRotation</code> is TRUE) has been fixed in <code>AIS_Manipulator::ObjectTransformation()</code>. Start axes orientation (at the beginning of Rotation) is now used instead.</p>
<p>29107</p>	<p><i>Summary:</i> <code>SelectMgr_FrustumBuilder</code> constructor is not exported without arguments.</p> <p><code>Standard_EXPORT</code> has been added in <code>SelectMgr_FrustumBuilder.hxx</code></p>
<p>29109</p>	<p><i>Summary:</i> <code>AIS_Trihedron</code> – add option hiding arrows tips.</p> <p><code>Prs3d_DatumAspect::DrawDatumPart()</code> now handles new flag <code>ToDrawArrows()</code>.</p> <p>New option <code>-arrowTip</code> has been added in <code>vtrihedron</code>.</p>
<p>29122</p>	<p><i>Summary:</i> Improve <code>Font_BRepFont</code> to handle one-line-fonts.</p> <p>New property <code>SingleStrokeFont()</code> has been added in <code>Font_SystemFont</code>. <code>Font_BRepFont::renderGlyph()</code> now does not close contours when flag <code>SingleStrokeFont()</code> has been set.</p>
<p>29124 29125 29127</p>	<p><i>Summary:</i> Tests – failures when tests are executed via Remote Desktop connection.</p> <p>Protection against accessing null pointer has been added in <code>OpenGL_VertexBuffer::Create()</code>.</p> <p>OpenGL-related warnings in command <code>vreadpixel</code> are redirected to <code>cout</code> so that they do not contaminate the command output.</p>



<p>29124 29125 29127</p>	<p>OpenGL version check before retrieving <code>GL_SHADING_LANGUAGE_VERSION</code> string has been added in <code>OpenGL_Context::DiagnosticInformation()</code>.</p> <p>Out-of-memory writing within fallback View dump mode has been fixed in <code>V3d_View.cxx</code>.</p>
<p>29137 29138</p>	<p><i>Summary:</i> <code>D3Dhost_FrameBuffer</code> should provide software fallback when <code>WGL_NV_DX_interop</code> is unavailable.</p> <p><code>D3Dhost_FrameBuffer</code> now provides fallback code copying OpenGL FBO content into D3D surface (slow).</p> <p><code>D3Dhost_FrameBuffer</code> releases Depth texture and FBO index.</p> <p>FBO dump implementation has been removed from <code>OpenGL_Workspace::BufferDump()</code>.</p>
<p>29147</p>	<p><i>Summary:</i> <code>D3Dhost_FrameBuffer::BindBuffer()</code> fails on some Intel drivers.</p> <p><code>D3Dhost_FrameBuffer::BindBuffer()</code> now implicitly detaches Depth+Stencil texture in case of driver failure.</p> <p><code>D3Dhost_View::d3dCreateRenderTarget()</code> now does not request Depth+Stencil texture by default.</p>
<p>29158</p>	<p><i>Summary:</i> Suspicious pass-through of case labels in switch statements.</p> <p>Incorrect fallthrough from <code>MeshVS_SMF_Mesh</code> to <code>MeshVS_SMF_Group</code> has been fixed in <code>MeshVS_Mesh::ComputeSelection()</code>.</p>
<p>29165</p>	<p><i>Summary:</i> Misuse of enumeration in <code>Prs3d_DatumAspect</code>.</p> <p>Methods <code>SetDrawFirstAndSecondAxis()</code> and <code>SetDrawThirdAxis()</code> of the class <code>Prs3d_DatumAspect</code> have been corrected to ensure that <code>myAxis</code> may be set only to valid values of the enum, and avoid unsafe operations.</p>
<p>29184</p>	<p><i>Summary:</i> <code>DrawWindow::Save()</code> fails when using WinCodec with PNG codec.</p> <p><code>DrawWindow::Save()</code> now uses <code>Image_Format_BGR</code> instead of <code>Image_Format_BGR32</code> for better compatibility with image encoders when dumping WinAPI bitmap.</p>
<p>29225</p>	<p><i>Summary:</i> <code>Font_FTFont::AdvanceX()</code> retrieves kerning value for incorrect characters pair.</p> <p>A misuse of <code>FT_Get_Kerning</code> has been fixed within <code>Font_FTFont::AdvanceX()/Font_FTFont::AdvanceY()</code>.</p> <p><code>Font_FTFont::LoadGlyph()</code> avoids returning TRUE if a method is called with 0 argument for a second time and more.</p>





<p>29262</p>	<p><i>Summary:</i> AIS_InteractiveContext::Load() does not register Object in the Viewer.</p> <p>AIS_InteractiveContext::Load() now loads the object regardless of the specified selection mode and decomposition flag.</p> <p>AIS_InteractiveContext::Load() and ::KeepTemporary() register object in the Viewer in the same way as ::Display() does.</p> <p>Draw Harness command vdisplay has been extended with new flag -erased to load object into context in erased state.</p>
<p>29283 29285 29286 29658</p>	<p><i>Summary:</i> allow defining more than 8 light sources.</p> <p>OpenGL_ShaderManager now overrides THE_MAX_LIGHTS within built-in shading programs so that the maximum number of lights is now limited only by OpenGL hardware (e.g. the length of GLSL program, number of defined uniforms, result performance, etc.).</p> <p>THE_MAX_CLIP_PLANES is now also defined by OpenGL_ShaderManager, so that unused lights and clipping planes do not reserve extra uniforms in GLSL programs.</p> <p>V3d_View::SetLightOn() has ceased to throw exception, when the number of lights exceeds 8. Instead, OpenGL_ShaderManager::PushLightSourceState() emits warning in case of usage of FFP providing consistent behavior with Clipping Planes number limit.</p>
<p>29290</p>	<p><i>Summary:</i> TKOpenGL – allow defining Light source per Zlayer.</p> <p>Graphi c3d_Cl i ght is now defined as a class inheriting Standard_Transient, so that its fields now should be accessed through methods. New property Graphi c3d_Cl i ght::IsEnabled() allows disabling light source everywhere. Confusing alias OpenGL_Li ght has been removed.</p> <p>The upper limit 1.0 of attenuation factors has been removed in Graphi c3d_Cl i ght::SetAttenuati on() since it contradicts to OpenGL specs and does not make sense.</p> <p>The list of light sources Graphi c3d_Zl ayerSetti ngs::Li ghts() is now a property of Zlayer. When defined, it overrides light sources defined for View/Viewer. New class Graphi c3d_Li ghtSet has been defined to define a set of light sources.</p> <p>The obsolete interface for debug drawing lights sources has been removed from V3d_Li ght. V3d_Li ght is now an alias to Graphi c3d_Cl i ght. V3d_TypeOfLi ght is now defined as a typedef to Graphi c3d_TypeOfLi ghtSource.</p>
<p>29295 29602</p>	<p><i>Summary:</i> TKOpenGL – provide distance culling option.</p> <p>New properties Graphi c3d_Zl ayerSetti ngs::Cul l i ngDi stance() and ::Cul l i ngSi ze() have been added to configure culling of small and distant objects, disabled by default.</p> <p>OpenGL_BVHTreeSelector now handles size culling and distance culling in addition to frustum culling.</p>





29300	<p><i>Summary:</i> TKOpenGL – provide depth pre-pass option.</p> <p><code>OpenGL_LayerList::Render()</code> now handles new option <code>Graphi c3d_RenderingParams::ToEnableDepthPrepass</code> which prepends additional pass to rendering pipeline filling Depth Buffer in advance.</p>
29331	<p><i>Summary:</i> TKOpenGL – make <code>OpenGL_PrimitiveArray::IsFillDrawMode()</code> as virtual method of <code>OpenGL_Element</code>.</p>
29337 29507	<p><i>Summary:</i> TKOpenGL – visual artifacts on Intel Broadwell GPU.</p> <p>Enable multiple draw buffers in shader program only if it is required by a specific application.</p> <p><code>occSetFragColor()</code> – a new GLSL function has been introduced as an alternative to setting <code>occFragColor/occFragCoverage</code> variables.</p> <p>TKOpenGL – uninitialized class field <code>OpenGL_FrameBuffer::myIsOwnDepth</code> has been fixed.</p>
29346 29365	<p><i>Summary:</i> TKOpenGL – collect frame statistics.</p> <p>The following tools collecting statistics internally have been implemented in TKOpenGL for performance analysis:</p> <ul style="list-style-type: none"> <li>▪ New option <code>Graphi c3d_RenderingParams::ToShowStats</code> displays rendering statistics.</li> <li>▪ New class <code>OpenGL_FrameStats</code> accumulates frame statistics used for the currently rendered context.</li> <li>▪ <code>OpenGL_View::Redraw()</code> and <code>OpenGL_View::RedrawImmediate()</code> reset counters within <code>OpenGL_Context::FrameStats()</code>.</li> <li>▪ <code>OpenGL_Layer::UpdateCulling()</code> simplifies resetting of culling state for cullable structures.</li> </ul>
29350	<p><i>Summary:</i> <code>OpenGL_Text</code> – add <code>Aspect_TODT_SHADOW</code> text style.</p> <p>New style <code>Aspect_TODT_SHADOW</code> draws a tiny shadow at the right-bottom corner with one pixel shift, producing a much nicer visual look than <code>Aspect_TODT_DEKALE</code>.</p>
29366	<p><i>Summary:</i> <code>OpenGL_Text</code> – artifacts when using <code>Aspect_TODT_SHADOW/Aspect_TODT_DEKALE</code> at different zoom level.</p> <p><code>OpenGL_Text</code> now applies Polygon Offset instead of Z-shift in world coordinates for drawing background.</p> <p><code>SetPolygonOffset()</code> method has been moved from <code>OpenGL_Workspace</code> to <code>OpenGL_Context</code>.</p>
29372	<p><i>Summary:</i> <code>Graphi c3d_TransformPers</code> – improve description of Local Coordinate system defined by Transformation Persistence.</p>
29395	<p><i>Summary:</i> <code>V3d_View</code> – Grid disappears forever after enabling Ray Tracing.</p> <p>Custom <code>Graphi c3d_Structure</code> implementation has been added to <code>V3d_RectangularGrid</code> and <code>V3d_CircularGrid</code> to trigger recomputation in case of device lost. Primitive arrays are no more (re)computed while grid is not actually displayed.</p>





29474	<p><i>Summary:</i> TKOpenGL – GLSL compilation errors on buggy OpenGL ES driver for PowerVR SGX 544MP</p> <p><b>OpenGL_ShaderProgram::Initialize()</b> now defines <b>THE_MAX_LIGHTS/</b> <b>THE_MAX_CLIP_PLANES</b> to zeros to provide a workaround for problems with buggy OpenGL drivers.</p>
29477	<p><i>Summary:</i> TKOpenGL – MSAA FBO initialization failure on OpenGL ES 3.2 device.</p> <p><b>OpenGL_View::myFboColorFormat</b> is now initialized using input texture format <b>GL_RGBA8</b> on mobile platforms (as on a desktop platform).</p>
29491	<p><i>Summary:</i> AIS_Shape – filter unsupported Display Modes within <b>::AcceptDisplayMode()</b>.</p> <p><b>AIS_Shape::AcceptDisplayMode()</b> now accepts only modes 0,1 and 2. <b>AIS_ColoredShape::Compute()</b> no more computes presentation for unknown display mode.</p>
29500	<p><i>Summary:</i> AIS_Point dynamic highlighting is not drawn on <b>RedrawImmediate</b>.</p> <p><b>Zlayer</b> for Dynamic highlighting of <b>AIS_Point</b> has been set to <b>Graphi c3d_ZlayerId_Top</b> and for Selected highlighting to <b>Graphi c3d_ZlayerId_UNKNOWN</b> to follow the behavior of normal AIS object.</p>
29503	<p><i>Summary:</i> TKOpenGL – fix access violation due to misprint in <b>OpenGL_AspectMarker</b></p>
29508	<p><i>Summary:</i> TKOpenGL – visual artifacts on Adreno 305/308.</p> <p><b>OpenGL_ShaderManager</b> now:</p> <ul style="list-style-type: none"> <li>▪ prefers GLSL ES 100 over GLSL ES 300 on devices reporting OpenGL ES 3.0;</li> <li>▪ prefers GLSL ES 300 on devices reporting OpenGL ES 3.1+.</li> </ul> <p>This provides a workaround for known buggy implementations of OpenGL ES 3.0 drivers.</p>
29509	<p><i>Summary:</i> TKOpenGL – Weighted OIT + MSAA shader compilation errors.</p> <p><b>OpenGL_ShaderManager</b> has been improved to fix implicit cast <b>ivec2-&gt;vec2</b> and specify GLSL version to "320 es" on appropriate devices.</p>
29517	<p><i>Summary:</i> Introduce <b>AlphaMode</b> property.</p> <p>New property <b>AlphaMode</b> from class <b>Graphi c3d_AlphaMode</b> defines how Alpha value should be treated.</p>
29519	<p><i>Summary:</i> TKOpenGL – fallback to <b>Graphi c3d_TOSM_FACET</b> from Gouraud/Phong when nodal normals are undefined.</p> <p><b>Graphi c3d_TOSM_VERTEX</b> and <b>Graphi c3d_TOSM_FRAGMENT</b> fall back to <b>Graphi c3d_TOSM_FACET</b> instead of <b>Graphi c3d_TOSM_UNLIT</b> when no normal attributes are defined for triangles array. As a result, <b>Graphi c3d_TOSM_UNLIT</b> Shading Model or material should be specified explicitly without reflecting properties to preserve the old behavior.</p>



29595	<p><i>Summary:</i> Wrong validation of Anchor point for Radius Dimension.</p> <p>The validation of Anchor point for Radius Dimension has been improved in method AIS_RadiusDimension::IsValidAnchor.</p>
29667	<p><i>Summary:</i> TKV3d – User-defined texture coordinates corrupted by StdPrs_ShadedShape.</p> <p>The function fillTriangles from StdPrs_ShadedShape.cxx has been protected against void UV range of a face.</p>
29724	<p><i>Summary:</i> Add AIS_InteractiveContext::ClearDetected() undoing MoveTo() dynamic highlighting.</p> <p>New method AIS_InteractiveContext::ClearDetected() allows resetting the list of detected objects and clearing dynamically highlighted entity under the mouse cursor after the previous AIS_InteractiveContext::MoveTo().</p> <p>Draw command vmoveto has been extended with new argument - reset.</p>
29744	<p><i>Summary:</i> SelectMgr_ViewerSelector::PickedPoint() returns a wrong 3D point for objects with transformation persistence.</p> <p>SelectMgr_RectangularFrustum::DetectedPoint() now takes into account myScale.</p>
29768	<p><i>Summary:</i> TKOpenGL - structure is entirely clipped by suppressed clipping.</p> <p>The check for disabled state of the plane has been added in OpenGL_Structure::Render().</p> <p>Draw command vclipplane has been extended with new option - setOverrideGlobal.</p>
29791	<p><i>Summary:</i> Wrong result of SelectMgr_RectangularFrustum::IsClipped.</p> <p>SelectMgr_RectangularFrustum::computeClippingRange() does not skip depth range starting behind the ray.</p>

Data Exchange

27070	<p><i>Summary:</i> Segfault when transferring HLR-created shapes via STEPControl_Writer.</p> <p>Protection against null shape on writing has been added in XSControl_WorkSession. The status IFSelect_RetVoid will be returned in such case (instead of access violation).</p>
29029	<p><i>Summary:</i> Exception is raised with no result during reading file 2033zsh1_1.stp.</p> <p>Static function stepstrcmp() from StepData_StepReaderData.cxx has been replaced by plain strcmp() to compare the full strings (stepstrcmp() returned true if one of the strings was longer than the other but the common part was equal).</p> <p>Protection has been added to avoid exception for cases when representation entities are NULL.</p>

29119	<p><i>Summary:</i> Documentation for PMI in XCAF.</p> <p>Documentation for GD&amp;T, Clipping planes and Saved view components has been added to the XDE User's Guide.</p>
29282	<p><i>Summary:</i> UpdateAssemblies is not working for located root assemblies.</p> <p>XCAFDoc_ShapeTool has been modified to check for root assemblies having their own location (when free shape is an instance for main assembly).</p>
29338 29737	<p><i>Summary:</i> Add Planes for Tolerance zones in Geometric tolerances.</p> <p>The possibility to store Tolerance zones defined by orientation or intersection planes has been added in XCAF as XCAFDimTolObjects_ToleranceZoneAffectedPlane.</p>
29362	<p><i>Summary:</i> Crash during reading step file.</p> <p>Additional check for wires has been added in STEPCAFControl_Reader.</p>
29391	<p><i>Summary:</i> Invalid import of TrimmedSurface.</p> <p>Import of TrimmedSurface has been fixed in IGESToBRep_TopoSurface.</p>
29403	<p><i>Summary:</i> Subshape names are not imported from STEP.</p> <p>The STEP processing of subshape names has been fixed in STEPCAFControl_Reader and STEPCAFControl_Writer. Broken subshapes creation in Document as tree has been replaced with plain subshapes structure.</p>
29436	<p><i>Summary:</i> Extend "Expand compounds" functionality.</p> <p>XCAFDoc_ShapeTool has been modified to expand (convert from a part to assembly) not only compounds, but other container shape types: compsolid, shell and wire.</p>
29525	<p><i>Summary:</i> PMI dimension names.</p> <p>Semantic PMI names translation from STEP to XCAF has been implemented in OCCT:</p> <ul style="list-style-type: none"> <li>▪ [Get/Set]SemanticName functions have been added to XCAFDimTolObjects_*Object classes;</li> <li>▪ X[Get/Set]GDTSemanticName draw commands have been added.</li> </ul>
29526	<p><i>Summary:</i> Test Harness command ReadIges does not support read.iges.onlyvisible mode.</p> <p>DRAW command ReadIges now takes into account the current setting of the parameter read.iges.onlyvisible.</p>
29597	<p><i>Summary:</i> Unable to read VRML2 file.</p> <p>VrmlData_Scene::createNode() now handles Collision item. VrmlData_ArrayVec3d::ReadArray() now handles a case with omitted brackets.</p>



<p>29599 29650</p>	<p><i>Summary:</i> Possible exception in shape tool.</p> <p>Expand compound operation has been fixed to properly calculate location of subshapes and provide correct sharing for new parts. Auto-naming has been switched-off for this operation.</p>
<p>29633</p>	<p><i>Summary:</i> Access violation in <code>StepVisual_PresentationStyleAssignment</code> while translating STEP file.</p> <p>Several checks for null have been added in STEP translation procedure.</p>

Draw

<p>28176</p>	<p><i>Summary:</i> Draw Harness – reshape command usage is not properly documented.</p> <p>The implementation of reshape command has been corrected according to OCCT coding rules.</p>
<p>29176</p>	<p><i>Summary:</i> Exception while projection 2D-point on 2D-line.</p> <p>DRAW command <code>2dproj</code> now can return not only 2D line, but also 2D point as extremum.</p>
<p>29304</p>	<p><i>Summary:</i> <code>DBRep_DrawableShape</code> – fix inappropriate use of unordered map.</p> <p><code>TColStd_DataMapOfIntegerInteger</code> has been replaced by <code>NCollection_Vector</code> in <code>DBRep_DrawableShape.cxx</code>.</p>
<p>29453</p>	<p><i>Summary:</i> Unclear syntax of add command.</p> <p>Help message for add command has been corrected.</p>
<p>29604</p>	<p><i>Summary:</i> Uniform mechanism providing History of shape modifications for OCCT algorithms in DRAW.</p> <p>The mechanism for unification of history commands has been implemented for all OCCT algorithms.</p> <p>The following Draw commands should be used to track the history of shape modifications of any operation:</p> <ul style="list-style-type: none"> <li>▪ <code>modified</code> finds the shapes modified from the given shape in the given history;</li> <li>▪ <code>generated</code> finds the shapes generated from the given shape in the given history;</li> <li>▪ <code>isdeleted</code> checks if the given shape has been deleted during operation.</li> </ul> <p>The mechanism allows fast and easy enabling of the DRAW history support for the algorithms supporting the history on the API level (i.e. the algorithm should have methods <code>Modified()</code>, <code>Generated()</code> and <code>IsDeleted()</code>).</p>
<p>29651</p>	<p><i>Summary:</i> <code>vtexture</code> command crashes.</p> <p>Null check has been added for "off" option of <code>vtexture</code> command to avoid access violation.</p>





29735	<p><i>Summary:</i> Command to set 2D mode for viewer in <code>ViewerTest</code> package.</p> <p>Draw command <code>viewinit</code> has been extended with new option <code>-2d_mode</code>.</p> <p>New command <code>view2dmode</code> switching on/off the mode has been added.</p>
29739	<p><i>Summary:</i> Command <code>viewonly</code> does not hide displayed objects.</p>
29784	<p><i>Summary:</i> Crash at STEP file reading with enabled sub-shapes.</p> <p>Method <code>STEPCAFControl_Reader::ExpandShell</code> has been protected against the case when <code>Connected_Face_Set</code> entity contains not only <code>FACE</code> entities.</p>

**Mesh**

29229	<p><i>Summary:</i> Crash at <code>Poly_Triangulation::Normal</code>.</p> <p>Creation of <code>gp_Dir</code> has been fixed in <code>Poly_Triangulation.cxx</code>.</p>
29715	<p><i>Summary:</i> Estimate the grid size of the acceleration structure by the complexity of the face.</p> <p><code>BRepMesh_DeLaurin</code> algorithm uses a grid as an acceleration structure for finding the circles and triangles, which can contain a point. Now the size of this grid is estimated basing on the complexity of the face and the desired face deflection.</p>

**Samples**

27736	<p><i>Summary:</i> Rectangle selection issues within MFC sample <code>Viewer3d</code>.</p> <p><code>Cviewer3dView</code>, <code>CanimationView3D</code> and <code>COCCDemoView</code> now use <code>AIS_RubberBand</code>.</p>
29069	<p><i>Summary:</i> Handle <code>UNICODE</code> filenames within C++/CLI <code>Csharp</code> sample.</p>
29083	<p><i>Summary:</i> Specify multiple Make jobs within <code>make.sh</code> for Qt sample.</p>
29140	<p><i>Summary:</i> Viewer is not updated in MFC Modeling and <code>Viewer3D</code> samples.</p> <p>OCC Viewer is now automatically updated after erasing objects, operation Common and drawing sphere.</p>
29393	<p><i>Summary:</i> <code>AndroidQt</code> sample build fails.</p> <p><code>AndroidQt</code> sample has been updated to take into account latest changes in OCCT:</p> <ul style="list-style-type: none"> <li>• Obsolete arguments in <code>AndroidQt</code> are now avoided within <code>V3d_View::SetWindow()</code> usage.</li> <li>• Missing <code>NativeFBConfig()</code> method declared in the interface has been added in <code>AndroidQt_Window</code>.</li> </ul>
29394	<p><i>Summary:</i> <code>IESample</code> contains strange STEP reading code.</p> <p>The order of operations in <code>Translate::importSTEP</code> procedure has been fixed: all STEP roots are transferred first and then all shapes are read. The resulting sequence is not discarded and recreated.</p>





<p>29470</p>	<p><i>Summary:</i> Eliminate references to deprecated Local Context from MFC sample.</p> <p>Methods <code>MoveTo()</code>, <code>Select()</code> and <code>ShiftSelect()</code> from <code>AIS_InteractiveContext</code> now throw an exception on invalid <code>V3d_View</code> argument instead of returning empty results.</p> <p><code>AIS_InteractiveContext::DetectedShape()</code> and <code>BeginImmediateDraw()</code> can be called without opened Local Context.</p> <p>Unused Draw commands <code>vsetam</code> and <code>unsetam</code> as well as methods <code>StandardModeActivation()</code>, <code>PickObject()</code> and <code>PickObjects()</code> from <code>ViewerTest</code> have been removed.</p> <p>Interactive input of Selection modes 0..7 now redirects to <code>vsel mode</code> instead of removed <code>ViewerTest::StandardModeActivation()</code>.</p>
<p>29559</p>	<p><i>Summary:</i> Wrong copyright statement in <code>FuncDemo</code>.</p> <p><code>FuncDemo</code> sample has been updated according to new <code>elasticones</code> example in Qt.</p>
<p>29571 29668</p>	<p><i>Summary:</i> Build Qt samples together with OCCT.</p> <p><code>BUILD_MODULE_QtSamples</code> flag has been provided in CMake to switch ON/OFF the compilation of Qt samples.</p>
<p>29631 29643</p>	<p><i>Summary:</i> build <code>AndroidQt</code> sample together with OCCT on Windows platform.</p> <p>The environment for building <code>AndroidQt</code> sample on Windows platform has been created.</p> <p><code>WIN32</code> definition now provides functionality for sample on Windows.</p> <p>In CMake procedure, <code>Qt5_FOUND</code> variable is now defined before compilation of modules. Search of Qt packages has been moved into <code>qt.cmake</code>.</p>
<p>29659</p>	<p><i>Summary:</i> Image is not displayed in <code>Viewer2d</code> MFC sample.</p> <p>Wrong Display Mode assigned to <code>Sample2D_Image</code> presentation has been fixed.</p>
<p>29674 29748 29800</p>	<p><i>Summary:</i> Improvements in Inspector tool.</p> <p>The following improvements have been implemented in Inspector tool:</p> <ul style="list-style-type: none"> <li>▪ Preferences now store user-defined state of positions and visibility of dock widgets, visibility and width of tree view columns, 3D view projection and the folder containing recently opened files;</li> <li>▪ New <code>ViewControl</code> package unites common functionality shared between different plugins;</li> <li>▪ New "Export to ShapeView" functionality processes Location and Orientation for external <code>TopoDS_Shape</code> object;</li> <li>▪ F5 key can be used to update the content of each plugin;</li> <li>▪ New "Visibility" column is available in the tree view;</li> <li>▪ New "Properties" tree view item presents a tree of current Filters of context.</li> </ul>





<p>29733 29743</p>	<p><i>Summary:</i> Inspector tool - crash after selecting <code>TNaming_UsedShapes</code> tree item.</p> <ul style="list-style-type: none"> <li>▪ <code>TNaming_UsedShapes</code> now avoids calling methods of an empty <code>TopoDS_Shape</code>;</li> <li>▪ <code>TNaming_NamedShape</code> avoids <code>NULL</code> <code>TNaming_RefShape</code> even if <code>TopoDS_Shape</code> is <code>NULL</code> (<code>TNaming_Builder::Delete</code>).</li> <li>▪ <code>DFBrowserPane</code> presentation tree item has been corrected</li> <li>▪ Obsolete methods of processing <code>SortedReferences</code> have been removed.</li> </ul>
<p>29741</p>	<p><i>Summary:</i> Inspector tool - wide icon size in the table of <code>TNamingNamedShape</code> attributes in <code>DFBrowser</code> plugin.</p>
<p>29747</p>	<p><i>Summary:</i> Inspector tool - start <code>DFBrowser</code> inside <code>FuncDemo Qt</code> sample.</p> <p>New Model-&gt;<code>DFBrowser</code> action starts Inspector tool with active <code>DFBrowser</code> plugin filled by the sample <code>OCAF</code> application.</p>
<p>29749</p>	<p><i>Summary:</i> Inspector tool - Remove "modified" column from <code>TNaming_NamedShape</code> presentation.</p>
<p>29781</p>	<p><i>Summary:</i> Inspector tool - history tree model is not set into external callback in <code>VInspector</code>.</p> <p>The following modifications have been introduced to fill a <code>VInspector_Callback</code> object created in a custom application by the <code>VInspector</code> history model:</p> <ul style="list-style-type: none"> <li>▪ <code>AIS_InteractiveContext</code> and <code>VInspector_ViewModelHistory</code> are set into <code>VInspector_Callback</code>;</li> <li>▪ <code>displaySelectedPresentations()</code> has been corrected to Hide/Show (by popup menu) any <code>AIS_InteractiveObject</code>, not only <code>AIS_Shape</code> (e.g. <code>AIS_Trihedron</code>).</li> </ul>

Documentation

<p>28660</p>	<p><i>Summary:</i> Describe how to fulfill LGPL terms in OCCT-based applications.</p> <p>It is now described in the Overview how to fulfill LGPL requirements when OCCT is used in proprietary applications.</p>
<p>29513</p>	<p><i>Summary:</i> Replace OCC logo in user guides.</p> <p>OCC user guides now show OCC logo in higher quality.</p>
<p>29545</p>	<p><i>Summary:</i> <code>Visualization.md</code> – article incorrectly specifies that <code>AIS_ConnectedInteractive</code> can define own <code>Material</code>.</p>
<p>29730</p>	<p><i>Summary:</i> <code>OCAF User Guide</code> updated for the case of attributes with a user-defined <code>GUID</code>.</p>



Configuration

22651	<p><i>Summary:</i> Impossible to build OCC as a static library due to using <code>Standard_EXPORT</code> instead of <code>Standard_API</code>.</p> <p>All library-specific macros for defining export / import properties of symbols on Windows (such as <code>Standard_API</code>, <code>_Draw_API</code>, <code>_math_API</code>, etc.) have been eliminated. Common macro <code>Standard_EXPORT</code> is used in all places where it is necessary.</p>
28090	<p><i>Summary:</i> <code>DRAWHOME</code> environment variable missing in CMake.</p> <p><code>DRAWHOME</code> variable has been replaced by <code>CSF_OCCTResourcePath</code> to run successfully <code>DFBrowse</code> command in Draw launched from Visual Studio.</p> <p>Missing icons of folders, attributes and named shapes used in <code>DFOpenImage</code> command have been added in <code>src\DrawResources\dftree.tcl</code>.</p>
28335	<p><i>Summary:</i> CMake – 3<sup>rd</sup>-party library names present in two places and are not synchronized with each other.</p> <p>Library names from file <code>adm/cmake/occt_csf.cmake</code> are now used to search for libraries.</p> <p>Hardcoded variants of tcl/tk library names used for searching have been removed.</p>
28971 29251	<p><i>Summary:</i> Problem compiling OCCT 7.2 with glibc 2.26.</p> <p><code>Standard_Local eSentry</code> does not include <code>xl ocal e. h</code> when using glibc anymore.</p> <p><code>HAVE_XLOCALE_H</code> has been renamed to <code>OCCT_CLOCALE_POSIX2008</code> to avoid confusion.</p> <p>Macros <code>OCC_CHECK_BASE_CLASS</code> has been renamed into <code>OCCT_CHECK_BASE_CLASS</code>.</p>
29075	<p><i>Summary:</i> Fix <code>TKService</code> linkage errors due to usage of GLX functions while using EGL.</p> <p>The use of GLX functions to choose Visual when building with <code>HAVE_EGL/HAVE_GLES2</code> options has been fixed in <code>Xw_Wi ndow</code>.</p>
29112 29113	<p><i>Summary:</i> <code>Image_VideoRecorder</code> – compilation fails on Ubuntu with <code>libavutil 54.x</code> (<code>Ffmpeg 2.7.6</code>)</p> <p>The macro <code>PixelFormat</code> has been undefined to allow compilation with <code>libavutil 54.x</code>.</p> <p>Coding rules on naming of classes have been revised to describe the correspondence of names of public types and files.</p>
29118	<p><i>Summary:</i> Incorrect generation of reference documentation for modules.</p> <p>Generation of reference documentation for single modules has been corrected to provide dependencies between modules in the graph.</p>
29129	<p><i>Summary:</i> Incomplete support of MSVS2017.</p> <p><code>MSVC_VERSION</code> is now used in CMake scripts instead of <code>MSVC10</code>, <code>MSVC11</code>, <code>MSVC12</code>, etc.</p>

29169	<p><i>Summary:</i> Fix compilation with undefined UNICODE on Windows.</p> <p>Use of TEXT macros and of OSVERSIONINFO instead of OSVERSIONINFOW has been eliminated.</p> <p>LoadIcon and LoadCursor are now used instead of LoadIconW and LoadCursorW when passing macros to standard resources (which depend on UNICODE flag).</p>
29249	<p><i>Summary:</i> Standard_Failure compilation fails on VS2013 + Intel Compiler due to unavailability of thread_local.</p> <p>INTEL_COMPILER version is now checked in combination with _MSC_VER on Windows.</p>
29250	<p><i>Summary:</i> TKIVtk – build failure with VTK 6.3+ due to removal of vtkRenderingFreeTypeOpenGL.</p> <p>vtkRenderingFreeTypeOpenGL has been removed from EXTERNLIB if vtk version 6.3.0 and above is used.</p>
29255	<p><i>Summary:</i> .gitignore – do not track generated files with extensions VC.db and VC.opendb.</p> <p>The files *.VC.opendb and *.VC.db generated by Visual Studio are not tracked by Git repository.</p>
29266	<p><i>Summary:</i> CMake install does not copy PDB files in Debug mode.</p> <p>The variable OCCT_INSTALL_BIN_LETTER is now defined only if the compiler is a version of Microsoft Visual C.</p>
29277 29297 29396	<p><i>Summary:</i> Mingw-w64 build fails for TKOpenGL due to missing link to OpenGL.</p> <p>The order of external libraries has been corrected in TKOpenGL /EXTERNLIB to mention high-level libraries earlier than low-level libraries, on which the former depend (e.g. GL 2Ps before OpenGL) and thus ensure that GCC linker can resolve dependencies.</p>
29317	<p><i>Summary:</i> CMake – CSF_d3d9 should be processed for building TKD3Dhost using MinGW.</p>
29377	<p><i>Summary:</i> CMake – linkage errors while using static OCCT libraries on Windows platform.</p> <p>Macro OCCT_STATIC_BUILD is now defined when building OCCT as Static libraries.</p>
29398	<p><i>Summary:</i> List lex and yacc files in the StepFile/FILES to avoid CMake warnings.</p> <p>Step.lex and step.yacc have been added to StepFile/FILES.</p>
29407 29589	<p><i>Summary:</i> Allow MFC samples to be built when OCCT is linked statically.</p> <p>CMake scripts have been corrected to perform search of libs and dlls of third-party libraries even for static builds of OCCT.</p> <p>The processing of errors in this case is relaxed: non-found DLLs are reported as warnings, and not found libs as warnings for a static build, and continuable errors for a shared build.</p>



<p>29407 29589</p>	<p>The code of samples allows building with OCCT linked statically. The implementation of the main application class now ensures that initialization is done after creation of all global objects.</p> <p>The recommendations about generation of static libraries have been added in the building guide.</p>
<p>29514</p>	<p><i>Summary:</i> CMake – OpenGL ES should be available for Linux.</p> <p>It is now possible to optionally build OCCT with GLESv2 and EGL on Linux</p>
<p>29547</p>	<p><i>Summary:</i> Upgrade. dat – include deprecated enums into section [rename].</p> <p>V3d_TypeOfShadingModel -&gt;Graphic3d_TypeOfShadingModel and V3d_TypeOfLight -&gt;Graphic3d_TypeOfLightSource renames have been added in upgrade. dat.</p>
<p>29639</p>	<p><i>Summary:</i> CMake – rename options for building samples.</p> <ul style="list-style-type: none"> <li>▪ BUILD_SAMPLES_MFC is now used instead of BUILD_MODULE_MfcSample;</li> <li>▪ BUILD_SAMPLES_QT is now used instead of BUILD_MODULE_QtSample;</li> <li>▪ Sub-folder samples/mfc/ now groups MFC samples;</li> <li>▪ Qt processing of *.ts resource files avoids creating excessive projects under Samples folder in VStudio.</li> </ul>
<p>29684</p>	<p><i>Summary:</i> Modification of a standalone build of Inspector tool.</p> <p>It is now possible to compile Inspector in a Standalone mode to use this tool for earlier versions of OCCT. Correspondingly:</p> <ul style="list-style-type: none"> <li>▪ The folder samples/tools/Tstandalone has been removed. CMake should use tools/CMakeLists.txt filename to build Inspector out of OCCT;</li> <li>▪ The folder TInspectorEXE has been moved from samples/tools/ to tools/</li> <li>▪ TInspectorAPI_Version.hxx provides compilation of Inspector with earlier versions of OCCT.</li> </ul>

**Coding**

<p>24574</p>	<p><i>Summary:</i> ICC compiler warnings on Windows.</p> <p>NCollection_UtfString and NCollection_UtfIterator classes have been refactored to use methods overloading instead of switches to dispatch implementation depending on character (Unicode code unit) size.</p> <p>ICC-specific preprocessor directives have been added to avoid warnings.</p> <p>Unused local functions and variables, class methods, unreachable statements, and extra throw() declarations reported by ICC have been removed.</p> <p>Usage of expl for the name of local variable is avoided as it conflicts with standard C function expl defined in math.h as preprocessor macro.</p> <p>Non-standard (MS-specific) argument envp has been removed from definition of main() function on Windows. Functions _main_ and _WinMain_ have been renamed to Draw_Main and Draw_WinMain, respectively, to avoid using names reserved in C++.</p>
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27034	<p><i>Summary:</i> Compilation of Products for Android on Windows and Linux platforms</p> <p>The compilation of Products for Android has been integrated into Windows and Linux platforms</p>
28934	<p><i>Summary:</i> Eliminate compiler warnings in OCCT samples.</p> <p>Qt warnings about compilation problems under MSVC 2013 and greater have been eliminated. Order of includes has been changed to avoid warning about <code>M_PI</code>, redefinition warning of <code>math.h</code>, etc.</p>
29151	<p><i>Summary:</i> Eliminate GCC compiler warnings <code>-Wimplicit-fallthrough</code>.</p> <p>New macro <code>Standard_FALLTHROUGH</code> has been defined for use in a switch statement immediately before a case label, if the code associated with the previous case label may fall through to that next label (i.e. does not end with "break" or "return" etc.).</p> <p>This macro indicates that the fallthrough is intentional and should not be diagnosed by a compiler that warns on fallthrough.</p>
29152	<p><i>Summary:</i> Eliminate GCC compiler warnings <code>-Wmisleading-indentation</code> when using MinGW.</p>
29156	<p><i>Summary:</i> Eliminate deprecation compiler warnings when targeting MacOS 10.12.</p>
29160	<p><i>Summary:</i> Appl eLang 9 compiler warning "binding dereferenced null pointer to reference has undefined behavior".</p> <p>Returning reference to null in <code>AppDef_MyLineTool</code> is now avoided.</p>
29164	<p><i>Summary:</i> GCC 7.1 compiler warnings <code>-Wmaybe-uninitialized</code> on <code>gp_XYZ</code> and siblings.</p> <p>The code has been corrected to avoid local variables of reference type pointing to fields of temporary objects.</p>
29170	<p><i>Summary:</i> GCC 7.1 warnings <code>-Wstrict-aliasing</code> in <code>Graphi c3d_ArrayOfPri mi ti ves. hxx</code>.</p> <p>Method <code>Graphi c3d_ArrayOfPri mi ti ves::SetVertexColor()</code> accepting color as three double RGB values and <code>Graphi c3d_Vec4ub</code> object have been refactored to avoid using <code>rei nterpret_cast</code> between pointers to complex types.</p> <p>A similar correction has been made in a static function <code>VdrawSphere</code> from <code>Vi ewerTest_Obj ectCommands. cxx</code>.</p>
29228	<p><i>Summary:</i> Define rule for avoiding header inclusion list pollution.</p> <p>It is now required that the source or header file should include only a minimal set of headers necessary for compilation, without duplicates (considering nested includes).</p>
29252	<p><i>Summary:</i> Eliminate GCC compiler warnings <code>-Wformat-overflow</code>.</p> <p><code>OSD_Di rectoryI terator</code> and <code>OSD_Fi leI terator</code> now use <code>TCol lecti on_Asci i String</code> instead of <code>unsafe 37pri nt</code>.</p>

29292	<p><i>Summary:</i> Remove <code>Graphi c3d_Vector</code> duplicating <code>gp_XYZ</code>.</p> <p><code>Graphi c3d_Vector</code> class has been replaced by classes <code>gp_Pnt/gp_XYZ/gp_Dir</code> depending on context.</p> <p>Unsafe float math causing out-of-range color results has been fixed in method <code>StdSelect_ViewerSelector3d::ToPixmap()</code>.</p>
29310 29542	<p><i>Summary:</i> Multiple compiler warnings in Inspectors.</p> <p>The following modifications fix compiler warnings in Inspectors:</p> <ul style="list-style-type: none"> <li>Specific header files <code>Standard_WarningsDisable.hxx</code> and <code>Standard_WarningsRestore.hxx</code> have been added to disable and restore compiler warnings (currently only MSVC compiler is handled.).</li> <li>Compiler warnings have been disabled for all includes of Qt headers.</li> <li>Warnings caused by floating point values in integer calculations are avoided.</li> <li>Use of <code>CMAKE_AUTOMOC</code> is avoided, header files are collected with <code>Q_OBJECT</code> iterating through project files.</li> </ul>
29376 29764	<p><i>Summary:</i> <code>TColStd_PackedMapOfInteger</code> – declare iterator as nested class of map collection.</p>
29419	<p><i>Summary:</i> Make <code>V3d_Viewer::PrivilegedPlane()</code> return const reference rather than a temp object.</p>
29492	<p><i>Summary:</i> <code>NCollection_IndexedDataMap</code> – add missing documentation to method <code>Add()</code>.</p>
29510	<p><i>Summary:</i> <code>IntWalk_Pwalking::PutToBoundary(...)</code> method results in appearing several coincident points in Walking-line.</p> <p>Check for coincident points has been added in <code>IntWalk_Pwalking</code> algorithm.</p>
29576	<p><i>Summary:</i> Remove unused declarations from package <code>Aspect</code>.</p> <p>Unused declarations <code>Aspect_TypeOfPrimitive</code>, <code>Aspect_TypeOfLayer</code>, <code>Aspect_TypeOfEdge</code>, <code>Aspect_TypeOfDrawMode</code>, <code>Aspect_TypeOfConstraint</code>, <code>Aspect_DriverDefinitionError</code> and <code>Aspect_BadAccess</code> have been removed.</p>
29582	<p><i>Summary:</i> <code>Bnd_Range</code> – inconsistent methods pair <code>GetMin()/GetMAX()</code>.</p> <p>The following modifications have been introduced in class <code>Bnd_Range</code>:</p> <ul style="list-style-type: none"> <li>Method <code>GetMAX()</code> has been renamed to <code>GetMax()</code>.</li> <li>New method <code>Add()</code> takes another <code>Bnd_Range</code> as argument.</li> <li>New methods <code>IsOut()</code> mimics a <code>Bnd_Box</code> interface.</li> <li>Methods <code>Shift()</code> and <code>Shifted()</code> no more modify Void range.</li> </ul>
29590	<p><i>Summary:</i> Avoid usage of <code>Standard_EXPORT</code> attribute for inline methods.</p> <p>All occurrences of <code>Standard_EXPORT</code> attached to inline methods in OCCT code have been eliminated. Some unused classes and C++ files producing no code have been deleted.</p>
29754	<p><i>Summary:</i> Replace <code>Standard_Integer</code> with <code>Graphi c3d_ZLayerId</code> for consistency.</p> <p><code>Standard_Integer</code> has been replaced with <code>Graphi c3d_ZLayerId</code> in methods <code>AIS_InteractiveContext::SetZLayer</code> and <code>PrsMgr_Presentation::SetZLayer</code>.</p>

## Supported Platforms and Pre-requisites

Open CASCADE Technology is supported on Windows (IA-32 and x86-64), Linux (x86-64), Mac OS X (x86-64), Android (ARMv7, ARM64 and x86), and iOS (ARM64) platforms.

The table below lists the product versions used by OCCT and its system requirements.

The most up-to-date information on Supported Platforms and Pre-requisites is available at <https://www.opencascade.com/content/system-requirements>.

<b>Linux Operating System</b>	Arch Linux, CentOS 6.4, CentOS 7.3, Fedora 22, Fedora 24, Ubuntu-1604, Debian 7.0, Debian 8.0
<b>Windows Operating System</b>	MS Windows 10 / 8 / 7 SP1 / Vista SP2 / XP SP3
<b>OS X/macOS Operating System</b>	OS X/macOS 10.10 and later
<b>Android Operating System</b>	Android 4.2 and above
<b>iOS Operating System</b>	iOS 7 and above
<b>Minimum memory</b>	512 MB, 1 GB recommended
<b>Free disk space</b> (complete installation)	650 MB of disk space, or 1,4 GB if installed with reference documentation
<b>Graphic library</b>	OpenGL 3.3+, OpenGL ES 2.0+
<b>C++</b> <i>For Linux:</i>  <i>For Windows:</i>  <i>For Mac OS X:</i>  <i>For Android:</i>	GNU gcc 4.3+ LLVM Clang 3+  Microsoft Visual Studio 2008 Microsoft Visual Studio 2010 SP1 Microsoft Visual Studio 2012 Update 4 Microsoft Visual Studio 2013 Update 2 Microsoft Visual Studio 2015 Microsoft Visual Studio 2017 Intel C++ Composer XE 2013 SP1 GCC 4.3+ (Mingw-w64)  XCode 6 or newer  GCC 4.8+ (android-ndk-r12+)
<b>TCL</b> (for testing tools) <i>For Linux:</i> <i>For Windows:</i>  <i>For OS X:</i>	Tcltk 8.6.3+ <a href="https://www.tcl.tk/software/tcltk/8.6.html">https://www.tcl.tk/software/tcltk/8.6.html</a> Tcltk 8.6.3+ <a href="https://www.tcl.tk/software/tcltk/8.6.html">https://www.tcl.tk/software/tcltk/8.6.html</a> or ActiveTcl 8.6 <a href="https://www.activestate.com/activetcl/downloads">https://www.activestate.com/activetcl/downloads</a> Built-in Tcl/Tk 8.6+
<b>Qt</b> (for demonstration tools)	Qt 4.8.6 <a href="https://download.qt.io/">https://download.qt.io/</a>
<b>FreeType</b> (OCCT Text rendering)	FreeType 2.4.11-2.7.1 <a href="https://www.freetype.org/">https://www.freetype.org/</a>
<b>FreeImage</b> (Support of common graphic formats)	FreeImage 3.17.0 <a href="http://freeimage.sourceforge.net/">http://freeimage.sourceforge.net/</a>
<b>gl2ps</b> (Export of OCCT viewer contents to vector graphic file, deprecated)	gl2ps-1.3.8 <a href="http://geuz.org/gl2ps/">http://geuz.org/gl2ps/</a>
<b>TBB</b> (optional tool for multithreaded algorithms)	TBB 4.x or 5.x <a href="https://www.threadingbuildingblocks.org/">https://www.threadingbuildingblocks.org/</a>
<b>Doxygen</b> (optional for building documentation)	Doxygen 1.8.5+ <a href="https://www.stack.nl/~dimitri/doxygen/download.html">https://www.stack.nl/~dimitri/doxygen/download.html</a>
<b>FFmpeg</b> (multimedia framework for OCCT video recording)	ffmpeg-3.3 <a href="https://www.ffmpeg.org">https://www.ffmpeg.org</a>