Data Exchange Best Practices

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Presenters Bio

Ram Eswaran

- Chief Technology Officer, Kubotek Kosmos (Marlborough, MA)
- 25 Years in the CAD/CAM software industry
- Areas of Expertise
  - CAD
  - Geometry Kernel
  - File Translators
- Kubotek representative at LOTAR International workshops
- PDES Board, PDES TAC, MBx-IF Implementor Group (STEP AP242)
- MS, BS Mechanical Engineering
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Kubotek Kosmos Product Lines

➢3D Framework (Engineering Software Development Framework)

- ❖Specialized Applications in CAD/CAM/CAE/Quality/Metrology
  - ✓Independent Software Vendors
  - ✓In-house IT Teams
  - ✓Software Contractors

➢CAD Utility Programs (3D Framework Foundation)

- ❖Manufacturing Supply Chain
- ❖Data Migration
- ❖Data Exchange
- ❖Products
  - ➢ Validate: CAD Model Translation Validation
  - ➢ Revision: Engineering Change Detection & Documentation
  - ➢ View / Convert: CAD File Viewing, Measurement & Conversion

➢KeyCreator (CAD)

Target Audience

- ❖Manufacturing Organizations (Contract Manufacturers, Mold Design, Tooling Shops, …)
- ❖Product/Concept Design

Notable Kubotek Kosmos Customers

Kubotek Software Customers

Data Exchange = Translation

- Data Exchange = Translation. Embrace it!

- What is involved?
  - File Format
    - Binary Data
    - Decryption
    - File Compression
    - Platform Architecture
    - Geometry (Shape of entities)
      - Understanding of similarities and differences between source system and target system
    - Topology (How are entities connected)
      - Understanding of similarities and differences between source system and target system
    - Assembly Structure, PMI, Lightweight Data, Metadata, etc.

  - Access to Database (Cloud software)
    - Requires
      - Permissions
      - API expertise

File Translation Scenarios

- LOTAR (Long term archiving and retrieval)
  - CAD Independent Backup

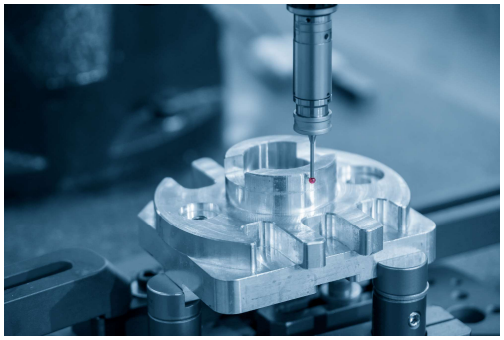
LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

- Data Migration
  - CAD Version Upgrade
  - CAD to CAD

CATIA v4 ⟶ v5

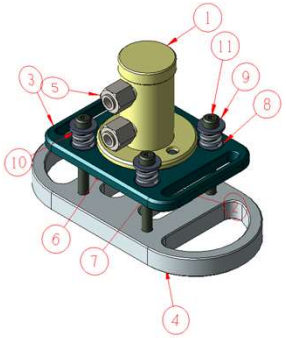
- Supply Chain

What is the target application?



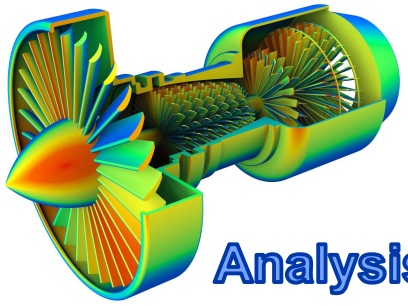
Quality

Manufacturing

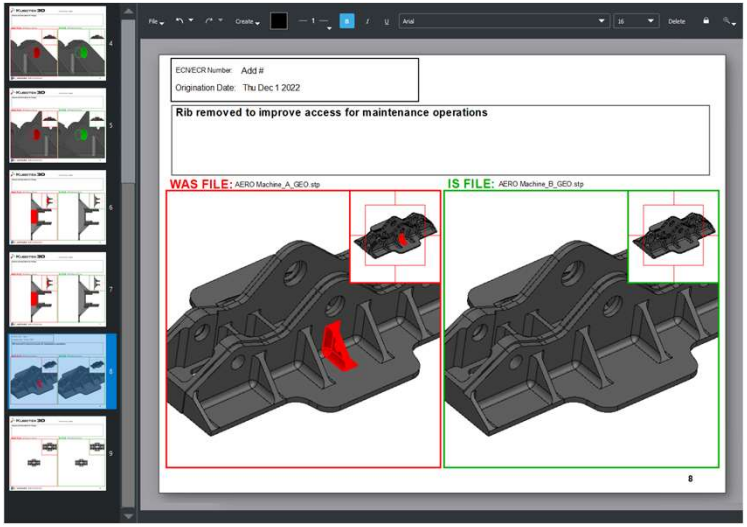


Item	Qty.	Part No. / Description
1	1	Pneumatic Cylinder
2	1	Piston
3	1	Base Plate
4	1	Press Plate
5	2	Quick Connect Fitting
6	3	1/4- 20 Hex Bolt
7	3	.25 Lock Washer
8	4	Bushing
9	4	Washer
10	4	Spring
11	4	2" 1/4-20 SH Shoulder Screw

Purchasing / Quoting



Analysis



Engineering Change

Data Exchange Considerations

- Same as authoring software
  - Use the native format!

- Different Software
  - Standard Format (STEP, JT, 3D PDF [PRC], QIF)
  - Kernel Format (Information not easily available)
    - Parasolid
      - SolidWorks, NX, Solid Edge, Mastercam, Onshape (Part Geometry Only!)
    - ACIS
      - *AutoCAD/Inventor*

❖ Things to consider
  - ❖ Does the target format have adequate support for all the data?
  - ❖ What are the authoring system's capabilities to write the data to various formats?
  - ❖ Is the target software able to read all required information from the target format?

Data Conversion Errors – Where and why do they happen?

Where?

- Source Data Set
- Derivative format created from source
- Target software read of source data OR derivative format
- Version Upgrades

Why?

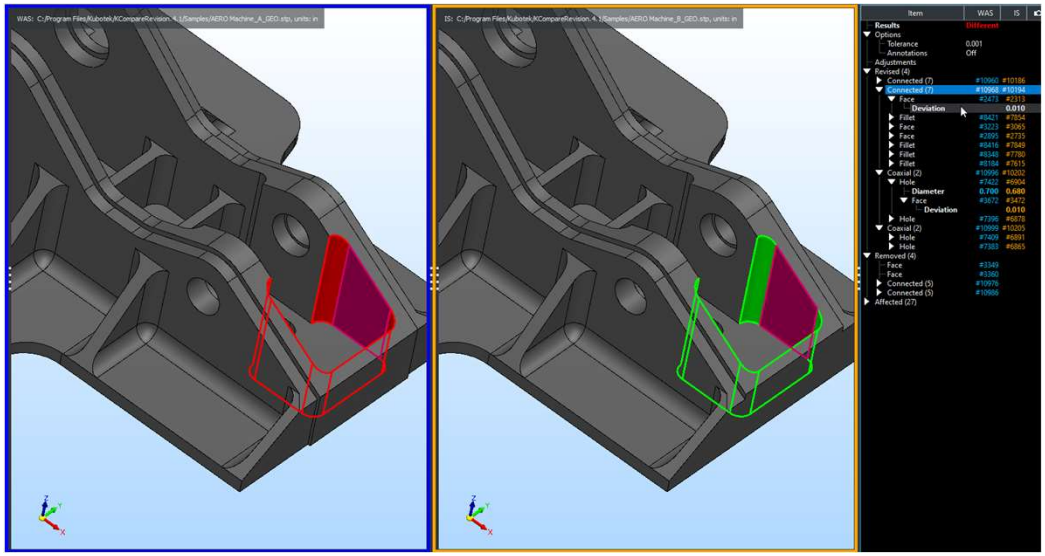
- Software Bugs
- Design Errors
- Gaps in capabilities between source and target formats
- Precision Differences (Varies from 1e-3 to 1e-6!) between formats
- Units Mismatch (INCH vs MM)
- Mapping Limitations
  - Geometry (Lines/Arcs/Conics, Planes/Spheres/Cones/Tori) vs Approximate Geometry (NURB/NUB)
  - Topology (Face = Surface + 3D Curve Boundary OR Surface + 2D/Parameter Curve Boundary)
  - PMI Maturity (Annotation Types, Association to Geometry)

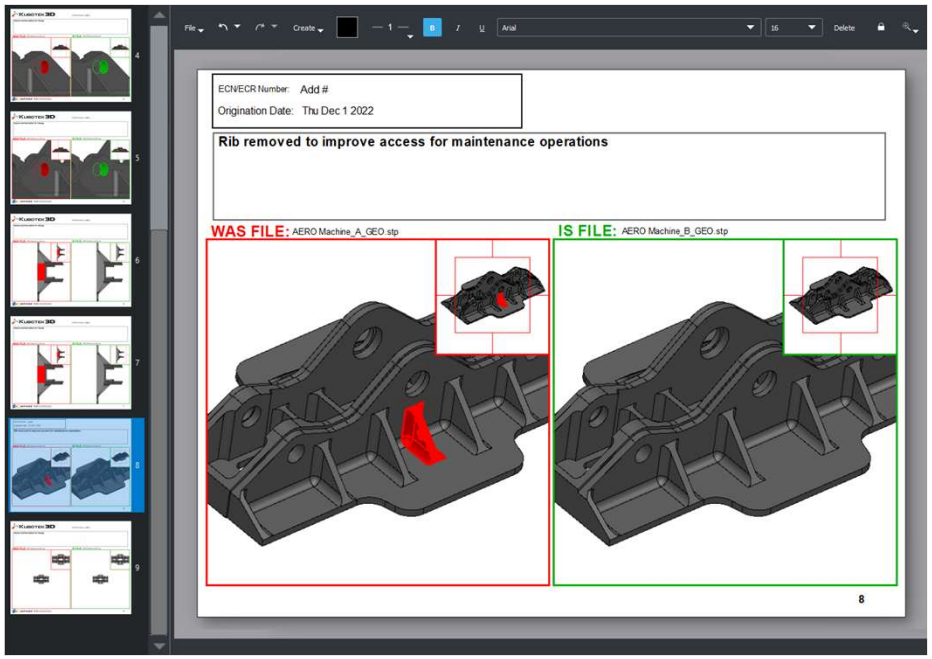
Define what Data needs to be Exchanged

- Assemblies?
- Part Geometry?
- Mesh (Visualization)
- Configurations? (Active or All)
- Construction Geometry?
- History Tree?
- Assembly Level Features?
- Specialized?
  - Publications
  - Composites
  - Electrical
  - Kinematics
  - Selection Sets
  - …
- GD&T?
  - Semantic? Graphical?
  - Part Level? Assembly Level
- Attributes?
  - Render (Color, Transparency, Line Width, Line Style, Textures, etc.)
  - Material Properties
  - Entity Visibility
  - Entity State (Active or Suppressed)
  - Persistent IDs
  - Part Properties / Parameters
  - Other Metadata
- 2D Drawings?

❖ Configure part so there is no ambiguity on what is intended to be consumed
  ❖ Hide or Remove unnecessary information
❖ Visually Communicate Changes (TDP/3D PDF, Report Creation Software – Kubotek Kosmos Revision)

Kubotek Kosmos Revision





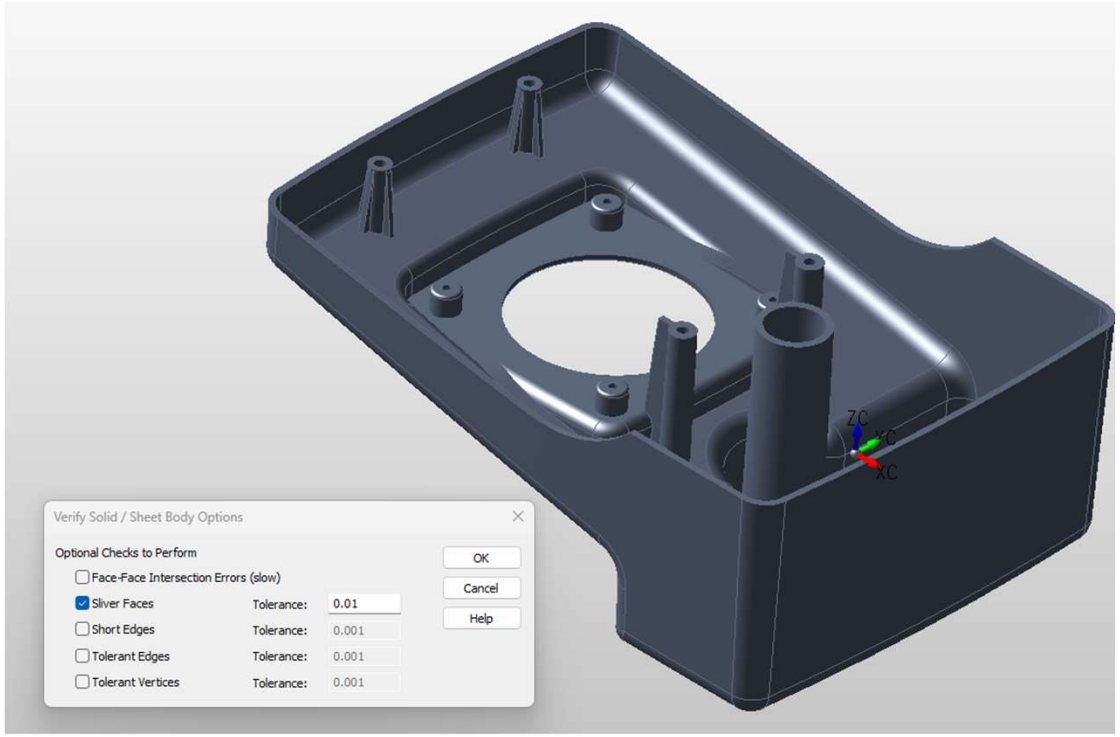
Data Integrity Checks

Authoring System

- Geometry Checks
- Round trip conversion
  - Check
  - Visual Examination (facets)
  - Overlay ("bitmap compare")
- CAD Independent Validation Tool

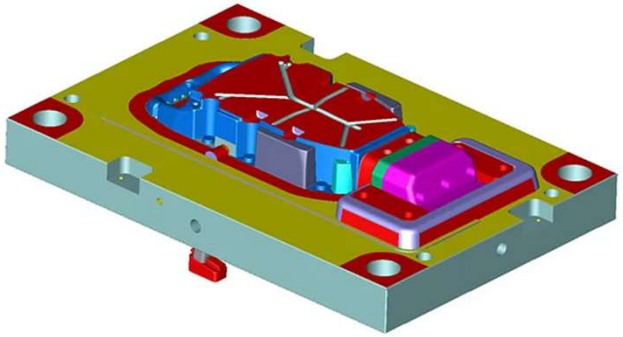
Receiving System

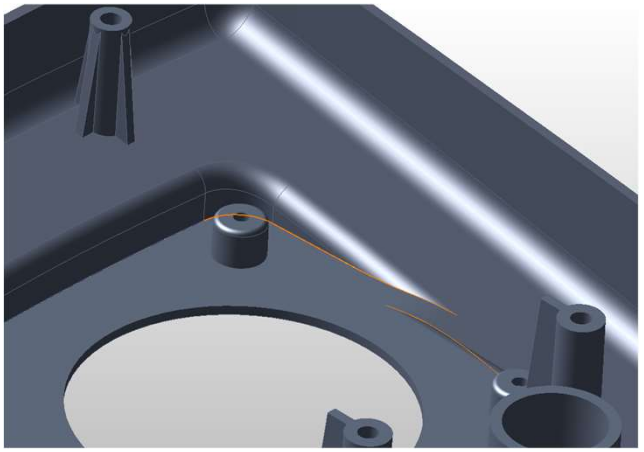
- Geometry Checks
- Visual Examination (facets)
- CAD Independent Validation Tool



Define Validation Criteria

- Tolerance
  - Use a reasonable value (ex. 0.01 X smallest machining tolerance)
- Split faces/edges
  - Face colors frequently used by mold designers.
- Sliver Faces / Tiny Edges
  - Cause CAE software problems
- Smart compare
  - Assembly Files
    - Compare Structure, followed by selective part compare

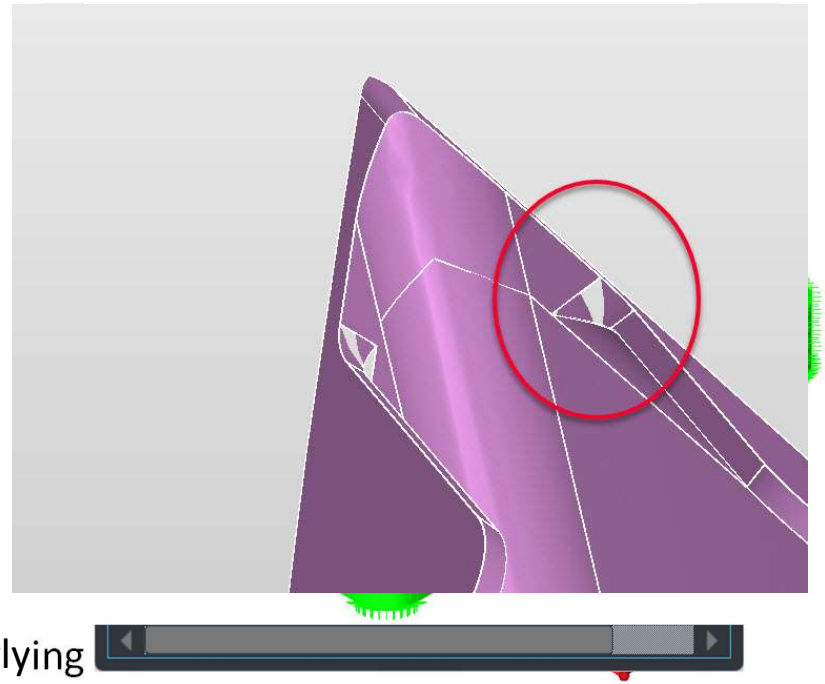




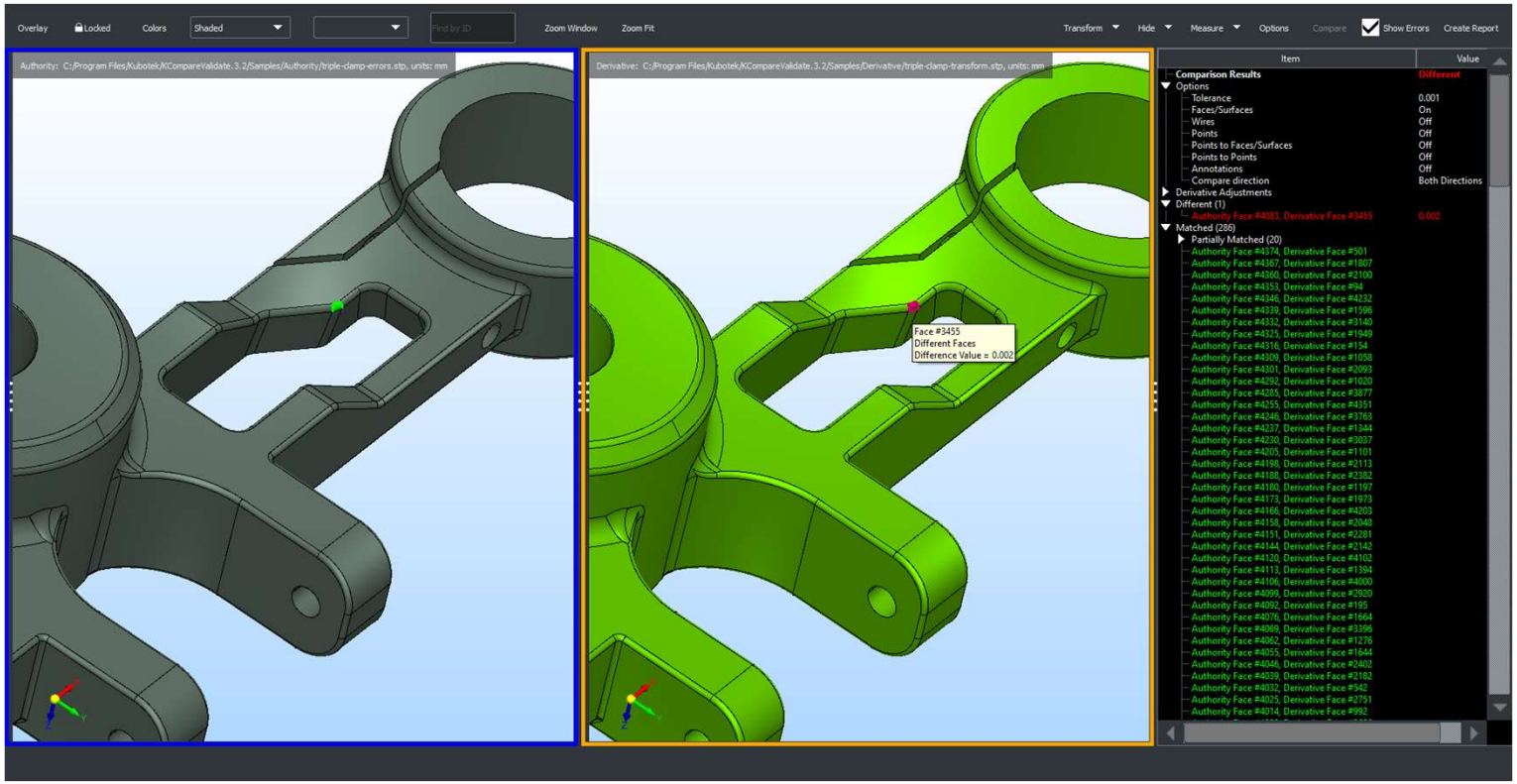
What to Validate?

Minimal Recommended Checks

- Entity Count
- Bounding Box
- Mass Properties (define acceptable deviation)
  - Volume
  - Surface Area
  - Center of Mass
- Point Grid
  - Quick check.
  - Point to face routines typically robust in geometry kernels.
- Graphical anomalies
  - Faceting issues can be an indication of problems with underlying
  - PMI text doesn't look right – invariably caused by use of CAD proprietary fonts or complex text attributes.



Validation Software - Comprehensive Check



Summary

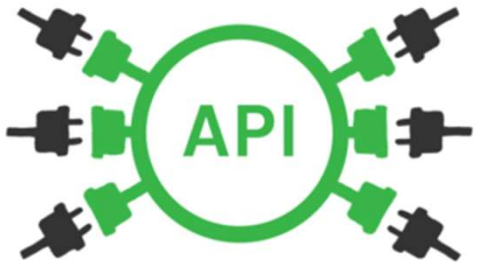
- Ensure Data Integrity at Source
- Limit data access/transfer to what is intended to be consumed
  - Reduces size of data
  - Ensures proprietary data does not slip through
  - Fewer points of failure
- Choice of vehicle
  - ❖ Does the target format have adequate support for all the data?
  - ❖ Is the target software able to read all required information from the target format?
  - ❖ What are the authoring system's capabilities to write the data to various formats?
- Validate authority and derivative files (both on sending side and receiving side)
- Document changes to prevent miscommunication.

What tools are available?

- Utilities within CAD software
  - Often limited
  - Self validation useful but minimal in scope

- Specialized end user products (Kubotek Kosmos Validate/Revision)
  - Functionality can possibly be accessed via
    - SDK (Software Development Kit) that wraps end user functionality in an API interface.
    - Command Line Access with a configuration file
    - Scope limited to how the end user product was designed and its purpose.

- API Libraries
  - Flexibility – Access and use your data the way you want to
  - Automation – Easier to integrate with PDM.
  - Batch Processing
  - Build custom tool to view differences



Kubotek Kosmos 3D Framework

1. Geometry Kernel
2. Multi-Processor Enabled - Built to be thread safe from the ground up.
3. Variable Precision Modeler - Designed to work with parts created in different geometry kernels.
4. CAD Neutral Universal Geometry & Topology Database (Assemblies, 3D, PMI, 2D, Meshes, Attributes, …)
5. Support for various CAD formats
   i. Neutral (STEP, IGES, STL)
   ii. Kernel (ACIS, Parasolid)
   iii. Native (Catia, NX, Creo, SolidWorks, Solid Edge, Inventor, AutoCAD)
6. Never Go Dark Code Pool – Daily Releases, 200,000 and growing regression test suite.
7. Platform Independent - Windows, Linux, MacOS, Android, *iOS*
8. Multiple programming interfaces - C/C++, .NET, Python
9. Multi-Language / Unicode Support, Journaling Support
10. Source code for end user View Product

Kubotek Kosmos 3D Framework Capabilities (Modules)

❖Core (Geometry/Topology, Feature Recognition, Faceter, Model Query, Part History, …)

❖Modeling (Entity Creation, Model Simplification, Modification & Repair, Hidden Line Removal)

❖Graphics (Display Library for Selection, Rendering, View Manipulation, Cutting Plane, …)

- ➢Display (Client – OpenGL 3 based)
- ➢WebGL (Browser)

❖Compare

❖Data Exchange

- ➢Neutral Format 1 (STEP, IGES, ACIS, STL – Read & Write)
- ➢Neutral Format 2 (Parasolid, JT, VDA, IFC – Read Only)
- ➢Direct CAD 3D Read (Catia 4/5/6, Creo, NX, SolidWorks, Solid Edge, Inventor, AutoCAD)
- ➢Direct CAD 3D Write (Parasolid, NX, SolidWorks, JT, Catia 5)
- ➢Direct CAD 2D Read (Catia 4/5, Creo, NX, Solid Edge)

3D Framework – Format & Application Support