IE360: CAD/CAM

Computer Aided Design and Computer Aided Manufacturing

Lecture (7)

Data Exchange between CAD/CAM Systems

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Outline

- Introduction
- IGES: Initial Graphics Exchange Specification
- STEP: STandard for the Exchange of Product Data
- De facto neutral formats
- Other Techniques

Introduction:

- Model data exchange
  - Why is it needed?
  - How it can be accomplished?
  - What formats for transfer?

- Data exchange: Background
  - Computer-aided design industry has grown extensively in recent years.
  - Competition between software developers has been high.
  - Many different proprietary CAD packages have been developed and installed.
  - Most use different formats to define the geometric data of model entities.

- Data exchange: Concept
  - Share geometric data between locations.
  - Share geometric data between different proprietary modelers and CAD systems.
  - Transfer geometric data to other software applications.
    - analysis, cnc, etc.
- Industry example: Auto industry
  - Traditional approach to design/manufacture
    - components designed by auto manufacturer.
    - components manufactured to specific instructions by suppliers.

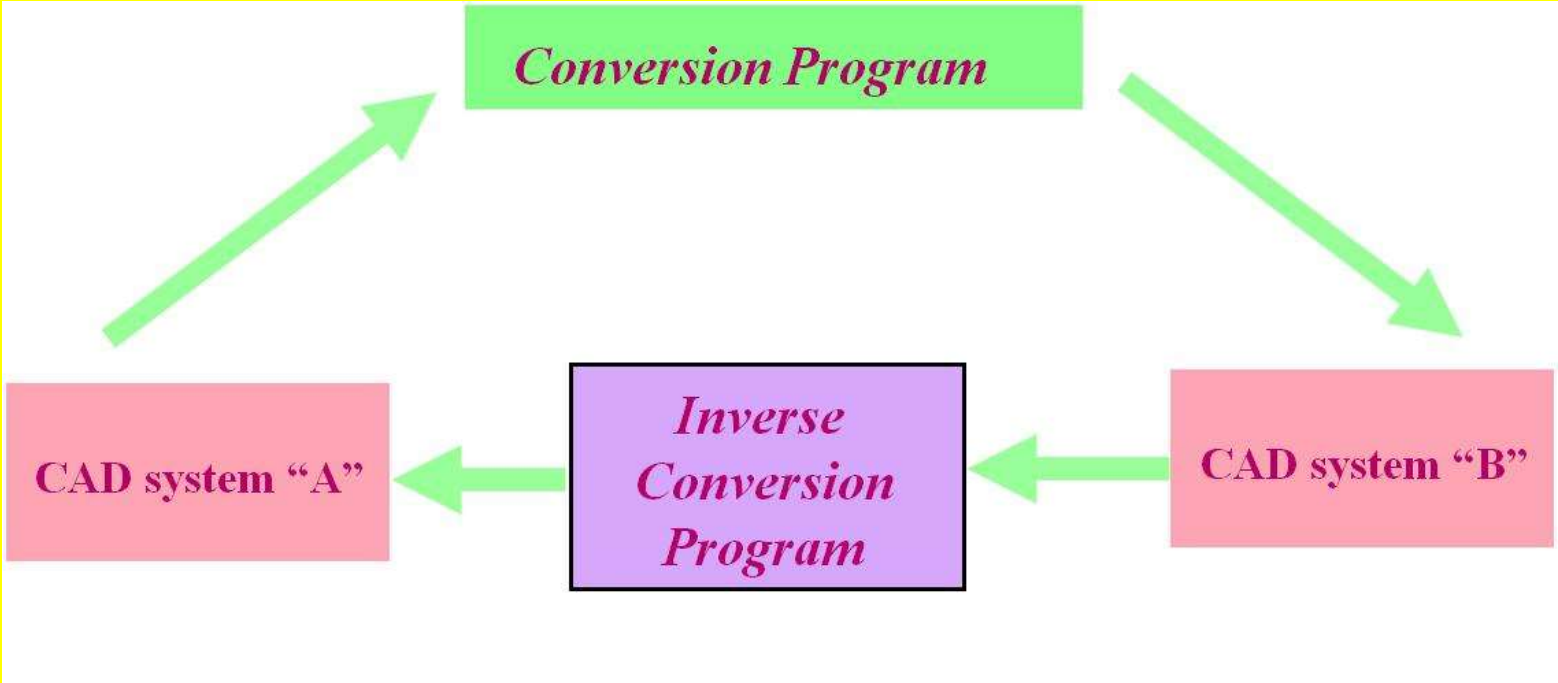
- Current trend
  - more design authority delegated to suppliers.
  - suppliers must match their designs to a number of specified variants.
  - to support process, great deal of design data must be exchanged.
  - this requires CAD systems of manufacturers and suppliers to be able to exchange geometric (and other) data.

➢ Data exchange: How to implement

- Three possible solutions to such an exchange problem.

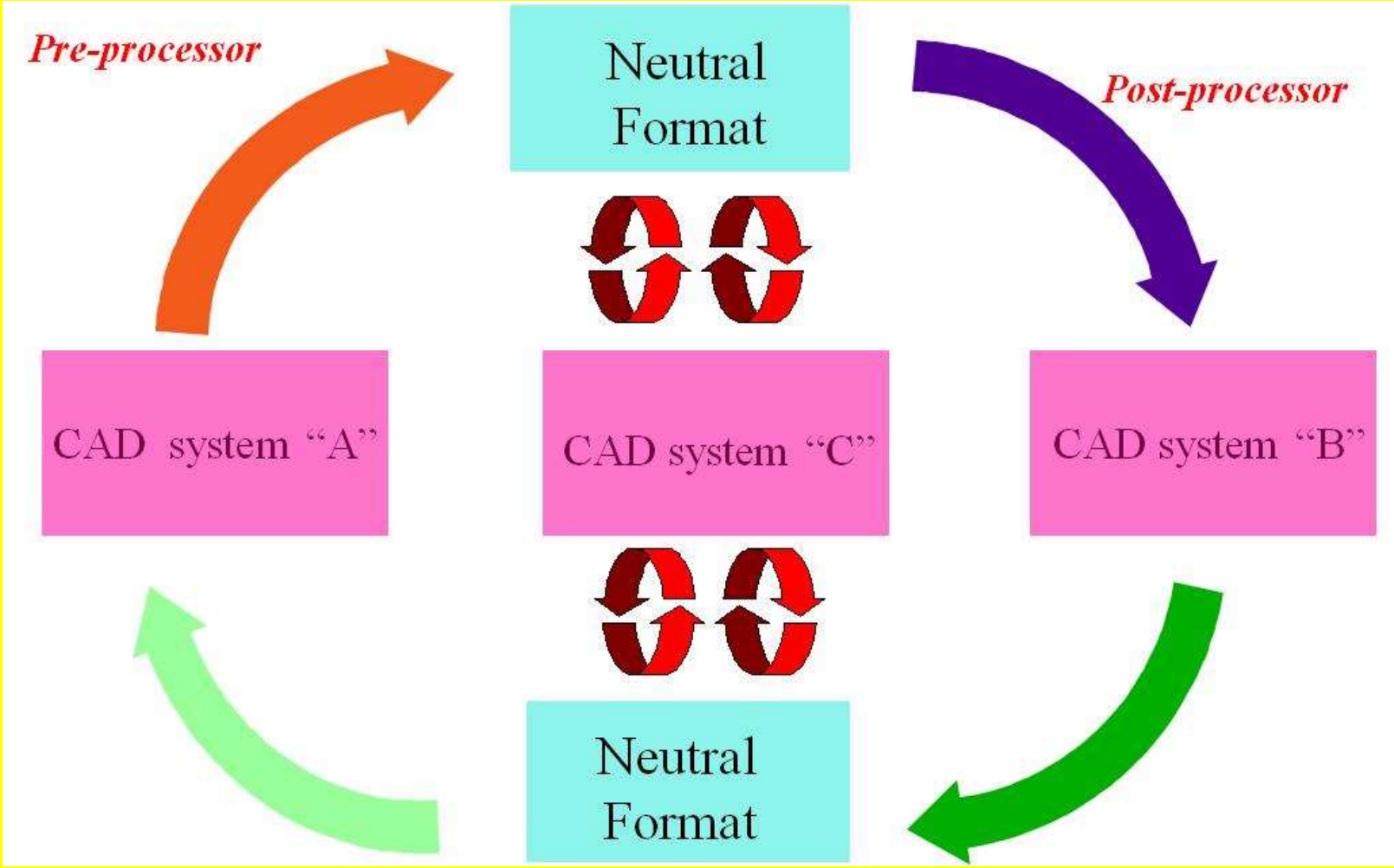
1. All use the same CAD package.

2. Use special translator applications to change data from one format to the specific one needed, as shown in the following figure.



- A single computer program, conversion program, is written. This converts the data produced by CAD system “A” into a form which can be read by another dissimilar system, CAD system “B”.
- Should it be necessary to return data from “B” to “A” then the inverse programme needs to be written.
- If another CAD system is added then further programs will be necessary to facilitate this.
- Difficulties arise where there are many CAD systems involved. The number of programs required would therefore become prohibitive.

3. Use a neutral format for data exchange, as shown in the following figure.



- The neutral format provides an alternative. Each CAD vendor provides a pre-processor for writing the neutral file and a post-processor for reading from the neutral file.

- Processors usually operate within CAD software
  - often written by software companies.

- With this approach the matter is less complicated where more CAD systems are added.

➢ Neutral format advantages

- Data descriptions able to be exchanged between CAD systems of various design.

- Allows users the option of changing/updating systems.

- Allows for the use of special application software, able to write directly to the format.

- Data exchange requires standardization:
  - A neutral format must be standardized.
  - Some standards have formal acceptance: National and International standards.
  - Some are de facto standards, developed by particular companies which choose to make the specifications public.

IGES: Initial Graphics Exchange Specification:

- Established in 1979 and accepted by ANSI (American National Standards Institute) in 1981.
- Format consists of a listing of entities and data.
- Stored in ASCII (American Standard Code for Information Interchange) coded text.
  - This binary format simplifies electronic transmission.

- Format used primarily for geometric data transfer
  - Does also support some non-geometric entities such as notes and dimensions.

- IGES entity example

Entity #	Entity Description
100	circular arc
108	plane
110	line
114	spline surface
118	ruled surface
126	NURB curve
150	CSG block
162	solid of revolution
206	diameter dimension

- IGES translation
  - Source file data examined:
    - create list of elements and defining data – lines, arcs, etc. with sizes, locations, endpoints...
  - Examine source entities and match to corresponding IGES entities.
    - for example, AutoCAD 2D line to entity #100 along with endpoint data.
  - List of IGES entities matched with native entity type is called an *entity map*.
  - Entity map then converted from neutral IGES format to destination format.
  - Once again, entity matching must take place.
  - IGES entity type and data matched to destination file format.

- How processors translate to and from IGES depends on who wrote translation software.

- Entity map obvious for some geometries.
  - e.g. common entities such as points and lines.

- Other matches not obvious
  - different software may support different geometry definitions.

  - example, spline curve may be 3rd order for one system and higher order for another.

➢ IGES Incompatibilities

- Pre-processor must match-up every entity in the sending system with a complimentary IGES entity.

- When choice is not obvious, selection becomes based upon the judgment of whoever wrote the translation software.
  - may also involve mathematical approximations and rounding.

- Similar problems exist at the postprocessing end of translation.
- User must consider limitations of both source and target software.
  - what entities supported (2D, 3D ... ?).
  - what data required in transfer (only geometry?, notes?)
- Since software firms create pre and post processors, proprietary attitude affects supported entities.
  - some companies hesitance to make too much info available.

➢ IGES standard has grown through versions to accept more entities

- Examples: Version 5.1 has:
  - 13 general note entities – for data such as superscript, subscript, justification…
  - 12 arrowhead forms – filled, open, triangular…

➢ More entities offers more choices to software designers but no CAD package supports all entities in IGES list.

- IGES and Solids:
  - Prior to 1988, no solid entities supported.
  - In 1988, *CSG* entities added to standard.
  - In 1991, *B-rep* entities added.
  - Vendors have been slow to include solids in translators.
  - Some vendors (often CAM software) perceived solid usage as low, with little demand.
  - Some felt IGES definitions too limited to support their solid data structures.
  - Plenty of old IGES versions still in use.

STEP: STandard for the Exchange of Product Data:

- STEP represents a new effort to establish a single, workable, internationally accepted standard.
  - Currently in state of evolution

- Extension of IGES, carries data definitions specific to mechanical and civil engineering.

- Will support more than simply geometric data.

- Interface for the exchange of data for the entire product development and production cycle.

- Includes both geometric and nongeometric data

- Non-geometric data
  - Test data supporting design

- Process planning for tooling, fabrication, assembly, quality assurance, etc..

➢ STEP standard is being used for solid geometry transfer but still in development.

- initial release in 1993

➢ US effort in support of international standard is ***PDES*** (*Product Data Exchange using STEP*).

<u>De facto neutral formats:</u>

➢ Gain acceptance through widespread use and availability.

➢ Developed by companies but source code made available.

➢ ***DXF***: *Data eXchange Format*

- AutoCAD data exchange format

Other Techniques :

- Many solid modelers beginning to use same solid geometry engine.
- Common choices are ACIS and Parasolid.
- Data can be shared directly between packages with same engine.
- Solid modeling engines

CAD Package	Manufacturer	Primary Format	Modeling Engine
AutoCAD Mechanical Dsktop	AutoDesk	B-Rep	ACIS
SolidEdge	EDS	B-Rep	Parasolid
SolidWorks	SolidWorks	B-Rep	Parasolid
➢MicroStation Modeler	Bentley	B-Rep	Parasolid
Pro/ENGINEER	➢Parametric Technologies	B-Rep	proprietary
SDRC-IDEAs	SDRC	B-Rep	Geomod
SolidDesigner	Hewlett Packard	B-Rep	ACIS
Unigraphics	EDS	B-Rep	Parasolid

- Example:
  - ACIS is used in
    - AutoCAD Mechanical Desktop
    - SolidDesigner
  - File written to *.sat* format (ACIS storage format) may be shared directly with no geometric data loss.

- Effective data exchange: Conclusions
  - Most exchange requires the use of data translators.
  - Requires the use of standardized, neutral formats (IGES, DXF).
  - At the current time, not 100% seamless, e.g. some error or loss of accuracy may occur with exchange.
  - Move to STEP standard and/or common solid engine will improve this.