History-based parametric exchange: the macro-parametric approach

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Outline

- Problem of current STEP AP203
- History-based parametrics
- Macro-parametric approach
- Persistent naming
Current STEP Transfer of Shape Models

- B-rep model is transferred. A ‘snapshot’ of an evolving model

- Missing data:
  - constructional history of the model
  - parameterization (design freedom)
  - geometric constraints (design restraint)
  - design features (high-level shape design constructs with possible links to functionality)

- This data is referred to as ‘design intent’. Without it, the transferred model cannot be parametrically edited after transfer – ‘dumb model’.
Procedural and explicit representations

1. d4 Nf6
2. c4 e6
3. Nc3 Bb4
4. Nf3 0-0
5. Bg5 c5
6. e3 cxd4
7. exd4 h6
8. Bh4 d5
9. Rc1 dxc4
10. Bxc4 Nc6
11. 0-0 Be7
12. Re1 b6
13. a3 Bb7
14. Bg3 Rc8
15. Ba2 Bd6
16. d5 Nxd5
17. Nxd5 Bxg3
18. hxg3 exd5
19. Bxd5 Qf6
20. Qa4 Rfd8
21. Rcd1 Rd7
22. Qg4 Rcd8
Activities in ISO

- Part 55 – Procedural and hybrid representation
- Part 108 – Parameterization and constraints for explicit geometric product modelling
- Part 109 – Enhanced assembly modelling with parameterization and constraints
- Part 111 – Construction history features
- Part 112 – Constructional history of 2D sketches
- AP 203 edition 2 and the CHAPS project of PDES
Parametrics Group of ISO

- ISO/TC184/SC4/WG12/Parametric Group
- Michael Pratt (LMR Systems & NIST)
- Noel Christensen (Honeywell), Rachuri Sudarsan (NIST), Bill Anderson (ATI), Ray Goult (LMR Systems), Tony Ranger (Theorem Solutions), Akihiko Ohtaka (Nihon Unisys), Nobuhiro Sugimura (Osaka Prefecture Univ),
Related works outside SC4

- OMG CAD Services
- Purdue EREP (Editable Representation)
- CAM-I: Application Interface Specification (AIS): Standard API
- DMAC OLE for Design and Modeling
- Djinn of UK
Motivation of macro-parametric

- Crash recovery in a **DBMS**: Transaction log file
- SQL (structured query language)
- MQL (modeling query language)?
- Macro file: History of user commands
Modeling history

- Sequence of modeling commands
- Log file, macro file, journal file, script file
- Regeneration of model inside the receiving CAD system
Neutral modeling commands

common set

Pro/E
CATIA
UG
IDEAS
SolidWorks
Implementation and tests

- SolidWorks
  - Macro file (swb file)
    - Pre-processor
      - Standard macro file
  - Post-processor

- CATIA V5
  - Macro file (Script file)
    - Post-processor

- Parametric changes
Implementation team of KAIST

**IDEAS**
- Ananda

**FEM**
- I.H. Song

**SKETCH**
- P.W. Hur

**TransCAD**
- B.C. Kim

**Persistent Naming**
- D.H. Mun

**Inventor**
- M.H. Cha

**Pro/E**
- D.H. Mun

**UG pre**
- H.K. Lee

**UG post**
- J.S. Hwang

**CATIA**
- S.U. Cheon

**SW Macro**
- J.H. Yun

**SW API**
- Erkan
Test Cases

1st L-block
2nd Y-model
3rd Gas Spring
4th Linear Sensor

5th engine airfilter housing
6th Pneumatics Cylinder
7th Chisel
Extrusion feature

Fillet feature

Vertical slot depth change 20 ➔ through all

Persistent naming problem in SolidWorks
ISO Standardization of P112

- ISO10303-112: Sketch Parametric
- SC4/WG12 N2478: 2003-10-28 WD
- Start of CD ballot (December 1, 2004)
- End of CD ballot (April 1, 2005)
- Scheduled Stage 4 DIS: 2005-12-01
- Scheduled Stage 5 FDIS: 2006-03-01
- Scheduled Stage 6 IS: 2006-09-01
Future

- Integration of persistent naming module
- Semantic interoperability based on ontology
- Collaboration (CSCW): sending message (command) rather than heavy B-rep model
Thanks
Why use a dual model? B-rep and procedural models have different, complementary characteristics

- B-rep
  - Provides explicit geometry for applications (e.g., visualization, NC machining)
  - Relative positioning easy
  - Parameterization hard
  - Attribute association easy
  - Verbose
  - Delicate

- Procedural
  - No geometry – just operations! No good for downstream applications
  - Relative positioning hard
  - Parameterization easy
  - Attribute association hard
  - Concise
  - Robust
Integration of translators

- Pro/Engineer Translator
- CATIA Translator
- SolidWorks Translator
- UG Translator

TransCAD
- Geometric Kernel
- XML Parser
- Persistent Naming

Additional modules

Std. Macro File (XML)

Automation APIs
Test cases of CHAPS project

*CAD files (CATIA& Pro/Engineer) + Modeling history
(1) Persistent naming
   (1.1) Naming
      (1.1.1) Basic naming
      (1.1.2) Solving ambiguity
   (1.2) Name matching
(2) Naming mapping

Taxonomy of persistent naming problem