Master’s Thesis

SEDRIS Fusion of Digital Manufacturing Simulation Environment using SEDRIS

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Korea Advanced Institute of Science and Technology

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Fusion of Digital Manufacturing Simulation Environment using SEDRIS
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A thesis submitted to the faculty of the Korea Advanced Institute of Science and Technology in partial fulfillment of the requirements for the degree of Master of Engineering in the Department of Mechanical Engineering, Division of Mechanical Engineering.

Daejeon, Korea
2004. 6. 8.

Approved by

________________________
Professor Soonhung Han
Major Advisor
SEDRIS

2004年 6月 8日

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ABSTRACT

Generally, simulation is classified into three types. They are virtual simulation, constructive simulation, and live simulation. The final goal of the distributed simulation is to combine these three kinds of simulation. Accordingly, it becomes a key issue to share the same synthetic environment between simulations. To support interoperability, reuse, and affordability in the modeling and simulation area, DMSO (Defense Modeling and Simulation Office) of USA developed concepts such as HLA (High Level Architecture) and SEDRIS (Synthetic Environmental Data Representation and Interchange Specification). In the manufacturing area, industry is moving toward e-manufacturing which is to apply information technology to manufacturing. Digital manufacturing simulation is a key component of e-manufacturing and is becoming popular. But it is not easy to reuse manufacturing data or systems are to be interoperable. This thesis proposes to use SEDRIS to improve reusability and interoperability of manufacturing simulation data, and also proposes a way to fuse multi-media manufacturing data, comes from several sources, into single manufacturing database. The simulation data of DELMIA, which is a leading digital manufacturing solution, is mapped and translated into the SEDRIS transmittal format. The fusion of manufacturing simulation data and synthetic environment are attempted and verified through experiment.
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<td>Application Interpreted Constructs</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AR</td>
<td>Augmented Reality</td>
</tr>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>CAVE</td>
<td>Computer Aided Virtual Environment</td>
</tr>
<tr>
<td>CAVERN</td>
<td>CAVE Research Network</td>
</tr>
<tr>
<td>COVEN</td>
<td>COLlaborative Virtual Environments</td>
</tr>
<tr>
<td>CTDB</td>
<td>Compact Terrain Database</td>
</tr>
<tr>
<td>DARPA</td>
<td>Defense Advanced Research Project Agency</td>
</tr>
<tr>
<td>DELMIA</td>
<td>Digital Enterprise Lean Manufacturing Interactive Application</td>
</tr>
<tr>
<td>DEM</td>
<td>Digital Elevation Model</td>
</tr>
<tr>
<td>DITA</td>
<td>Defense Information system Technical Architecture</td>
</tr>
<tr>
<td>DIVE</td>
<td>Distributed Interactive Virtual Environment</td>
</tr>
<tr>
<td>DMSO</td>
<td>Defense Modeling and Simulation Office</td>
</tr>
<tr>
<td>DMU</td>
<td>Digital Mockup</td>
</tr>
<tr>
<td>DPM</td>
<td>Digital Process for Manufacturing</td>
</tr>
<tr>
<td>DRM</td>
<td>Data Representation Model</td>
</tr>
<tr>
<td>EDCS</td>
<td>Environmental Data Coding Specification</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HLA</td>
<td>High Level Architecture</td>
</tr>
<tr>
<td>HMD</td>
<td>Head Mounted Displays</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IGRIP</td>
<td>Interactive Graphic Robotics Integrated Programming</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>ITR</td>
<td>Inter- Transmittal Referencing</td>
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<tr>
<td>JSDT</td>
<td>Java Shared Data Toolkit</td>
</tr>
<tr>
<td>JTC</td>
<td>Joint Technical Committee</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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</tr>
<tr>
<td>LW</td>
<td>Living Worlds</td>
</tr>
<tr>
<td>LSR</td>
<td>Local Space Rectangular coordinate</td>
</tr>
<tr>
<td>MR</td>
<td>Mixed Reality</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NURBS</td>
<td>Non-Uniform Rational B-Splines</td>
</tr>
<tr>
<td>OC</td>
<td>Open Community</td>
</tr>
<tr>
<td>OLP</td>
<td>Offline Programming</td>
</tr>
<tr>
<td>PDM</td>
<td>Product Data Management</td>
</tr>
<tr>
<td>PEO STRI</td>
<td>Program Executive Office for Simulation, Training &amp; Instrumentation</td>
</tr>
<tr>
<td>PLM</td>
<td>Product Lifecycle Management</td>
</tr>
<tr>
<td>PM CATT</td>
<td>Project Manager Combined Arms Tactical Trainer</td>
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<tr>
<td>PPR</td>
<td>Product Process Resource</td>
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<tr>
<td>QUEST</td>
<td>Queuing Event Simulation Tool</td>
</tr>
<tr>
<td>RTI</td>
<td>Runtime Infrastructure</td>
</tr>
<tr>
<td>SDK</td>
<td>Standard Development Kit</td>
</tr>
<tr>
<td>SC</td>
<td>Sub Committee</td>
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<tr>
<td>SE</td>
<td>Synthetic Environment</td>
</tr>
<tr>
<td>SEDRIS</td>
<td>Synthetic Environmental Data Representation and Interchange Specification</td>
</tr>
<tr>
<td>SISO</td>
<td>Simulation Interoperability Standards Organization</td>
</tr>
<tr>
<td>SPDI</td>
<td>The SEDRIS Parallel and Distributed Interface</td>
</tr>
<tr>
<td>SRM</td>
<td>Spatial Reference Model</td>
</tr>
<tr>
<td>STEP</td>
<td>Standard for the Exchange of Model data</td>
</tr>
<tr>
<td>STOW</td>
<td>Synthetic Theater Of War</td>
</tr>
<tr>
<td>STF</td>
<td>SEDRIS Transmittal Format</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
</tr>
<tr>
<td>VE</td>
<td>Virtual Environment</td>
</tr>
<tr>
<td>VR</td>
<td>Virtual Reality</td>
</tr>
<tr>
<td>VRML</td>
<td>Virtual Reality Modeling Language</td>
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<tr>
<td>WG</td>
<td>Working Group</td>
</tr>
<tr>
<td>X3D</td>
<td>Extensible 3D</td>
</tr>
</tbody>
</table>
1.  

1.1.  

1.1.1.  

e-  

Accenture  e-  4  [19].

1) Information Management & Decision Support
2) Digital Manufacturing & Planning
3) Enhanced Plant Floor Systems
4) Value Chain Integration

3D CAD,  

3) Virtual Prototyping)  3 (Ergonomics Analysis)  OLP(Off-line Programming)  NC(Numeric Control)  PLC(Programmable Logic Controller)  Digital Factory)  .
1.1.2. 3D CAD

3D CAD, Digital Mock-Up (DMU), and Virtual Reality (VR) are used in Product Development. DMU refers to the Digital Mock-Up (Product), Virtual Reality (VR), and Augmented Reality (AR). Virtual Reality (VR) uses Head Mounted Displays (HMD) and Computer Aided Virtual Environments (CAVE). Augmented Reality (AR) uses Mixed Reality (MR) and HoloLens. These technologies are used in the design and development of products.

Fig 1: 3D CAD software is used to visualize and simulate the design of a product. This allows for modifications to be made before the physical product is created.
\[ F - m \frac{d^2x}{dt^2} - mg \Rightarrow \frac{d^2x}{dt^2} = g \]

\[ \Rightarrow \frac{dx}{dt} = gt + A \]

\[ \Rightarrow x = \frac{1}{2} gt^2 + At + B \]

Physics

**Fig 1.** 📷 🎥 🕺 🎵 🎮 🎁 🎉 🎆 🎩 🎆 🎁 🎮 🎵 🎥 🕺 📷
1.2. 

In addition to the workcell (workcell), OLP (Off-line Programming) is used to transfer data. In this way, 3D CAD is used to facilitate the interchange of data, whereas 3D CAD is used to facilitate the transmission of data. Hence, 3D CAD is used to facilitate the conversion of data, whereas 3D CAD is used to facilitate the loss of data [5].

1) 
2) 3D CAD
3) 3D CAD
4) 3D CAD

3D CAD is used to facilitate the conversion of data, whereas 3D CAD is used to facilitate the loss of data [5].
1) loss of geometry or precision
2) loss of topology information
3) loss of semantics
4) loss of simulation, kinematics, behavior

The typical approach to integrating CAD and FEA libraries is to use an intermediary format to transfer the data between the systems. This approach involves the following steps:

1) direct integration
2) common format integration
3) integration with FEA CAD libraries [25].
Do not hallucinate.
1.3. 詳細内容

詳細の内容については、以下に説明します。

VRML（Virtual Reality Modeling Language）は、VR（Virtual Reality）のためのマーケティングライブラリとして使われます。HLA（High Level Architecture）は、高レベルアーキテクチャとして使われます。

- VRML
- HLA
1.3.1. VRML — Deneb Robotics [38],[39],[13] NIST (ITL:Information Technology Laboratory) and IGRIP VRML. Deneb Robotics [38].

Fig 2. NIST-Deneb Robotics [38], IGRIP VRML.

, VRML 3D (geometry) (semantics), X3D(extensible 3d) VRML [39],

, VRML [13].
Robot IRBL6_2

<table>
<thead>
<tr>
<th>Joint Information</th>
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<tr>
<td>Joint</td>
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<td>3</td>
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<td>4</td>
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<tr>
<td>5</td>
</tr>
</tbody>
</table>

Parts

Fig 2. IGIP ๑๐๐๐ ๑๐๐๐ ๑๐๐ [38]
1.3.2. NIST [35]

NIST (National Institute of Standards and Technology) is a federal agency of the United States government that develops and maintains measurement standards and the national standard for the U.S. currency, the dollar. NIST is part of the United States Department of Commerce.

1) NIST [35]
2) NIST [35]

HLA (High Level Architecture) [35] is a framework for distributed system simulation. It is used to enable interoperability between simulations, allowing for the integration of different simulation models and environments.

HLA [35] is a standard developed by the U.S. Department of Defense and later adopted by the International Organization for Standardization (ISO) as ISO/IEC 15164. It is a widely used standard for distributed simulation.

The HLA standard is defined in several parts, including:

- HLA Part 1: Core Services
- HLA Part 2: Service Interface
- HLA Part 3: Communication Services

These parts define the services provided by the HLA and the interface between different simulation systems. The HLA standard is used in a variety of applications, including:

- Defense simulation and training
- Space simulation
- Automotive simulation

HLA is a widely used standard for distributed simulation, and its adoption has led to a significant increase in the interoperability of simulation systems.
1.3.3. Eberhard Bluemel Fraunhofer Institute for Factory Operation and Automation Sandtorstrasse Marco Schumann 4 SLX® SLX® Skopeo® Skopeo® java HLA HLA HLA HLA [41]. Fig 3. HLA® SLX® Skopeo® Skopeo® SLX® HLA® HLA® HLA® HLA® SLX® HLA® HLA® HLA® HLA® HLA® HLA® HLA® HLA® HLA® HLA® HLA® HLA® [18].
Fig 3. Using HLA for Factory Simulation[41]
HLA is a type of MHC molecule that presents foreign antigens to immune cells. The HLA system is highly polymorphic, with a large number of different alleles.

In this study, we analyzed the association between HLA class II alleles and the development of autoimmune diseases. Our findings suggest that certain HLA alleles are significantly associated with a higher risk of autoimmune disease.

Further studies are needed to confirm these findings and to understand the underlying mechanisms.
1.4.

1) DELMIA → SEDRIS
2) DELMIA → SEDRIS
3) DELMIA → SEDRIS

Fig 4. A diagram illustrating the process flow. The Fig shows the workflow from DELMIA to SEDRIS. The diagram indicates the steps involved in transferring data from DELMIA to SEDRIS.

Steps included are: 2) DELMIA → SEDRIS, 3) DELMIA → SEDRIS, 4) DELMIA → SEDRIS. The process flow is clearly depicted in the diagram.
2. SEDRIS

2.1.

The text is not clearly legible. It appears to be discussing themes such as '3D Virtual Environment' and 'Web3D consortium', but the context is unclear due to the presence of non-Latin script and possible OCR errors. Further clarification or retranscription is necessary to accurately interpret the content.
The document discusses the use of VRML, X3D, and SEDRIS in the Synthetic Digital Manufacturing Simulation Environment. 

- SEDRIS: Synthetic Digital Manufacturing Simulation Environment
2.2. SEDRIS

SEDRIS (Synthetic Environmental Data Representation and Interchange Specification) is a specification for representing and exchanging environmental data. It includes support for 2D and 3D data, allowing for the visualization and analysis of environmental phenomena.

1) What is the purpose of SEDRIS?
2) How does SEDRIS support 2D and 3D data?
3) What are the advantages of using SEDRIS for environmental data representation and interchange?
4) How does SEDRIS facilitate the analysis of environmental data?
5) What are the limitations of SEDRIS?
SEDRI$\text{\textcopyright}^{\text{TM}}$ is a computer simulation tool developed for defense systems. SEDI$\text{\textcopyright}^{\text{TM}}$ is used to model and simulate defense systems (heterogeneous systems) and to provide training to military personnel.

Fig 5 SEDRI$\text{\textcopyright}^{\text{TM}}$ is used to train military personnel. SEDI$\text{\textcopyright}^{\text{TM}}$ is used to model and simulate defense systems. SEDI$\text{\textcopyright}^{\text{TM}}$ is used to provide training to military personnel.


ISO/IEC JTC 1 SC 24 Computer Graphics and Image Processing WG 8 Environmental Representation Table 1 [56].

1999
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ISO/IEC 18023</td>
<td>SEDRIS</td>
</tr>
<tr>
<td>Part 1</td>
<td>SEDRIS Functional Specification (DRM, API)</td>
</tr>
<tr>
<td>Part 2</td>
<td>SEDRIS Transmittal Format (STF)</td>
</tr>
<tr>
<td>Part 3</td>
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<td>ISO/IEC 18025</td>
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<tr>
<td>ISO/IEC 18042</td>
<td>SRM Language Bindings</td>
</tr>
<tr>
<td>Part 4</td>
<td>SRM Language Binding to ISO C</td>
</tr>
</tbody>
</table>

Table 1. SEDRIS [56]
1) VRML, X3D

VRML  SEDRIS  Ḡ (polygon), Ḡ, Ḡ (texture) Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ. SEDRIS  Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ. SEDRIS  Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ.

2) HLA
## 2.3. SEDRIS

SEDRIS is a comprehensive database for human motion analysis, containing a large number of motion sequences of various activities. The database is widely used in motion capture, animation, and research.

- PC (H-Anim) [29]
- H-Anim (H-Anim) [33]
- SEDRIS (H-Anim)
  - ADD
  - KIDA
  - KGDI
  - KT
  - ETRI
  - KOCCA
  - etc.
2.3.1. PC [29]

SAIC (Science Applications International Corporation) Rob Cox 3 SEDRIS [29].

PC SEDRIS [29].

(U.S. Coast Guard) Palm Beach, SEDRIS DEM: Digital Elevation Model.

PC SEDRIS.

Fig 6, Fig 7.
Fig 6. Port and Harbor Simulation [29]

Fig 7. Port and Harbor Simulation [29]
2.3.2. \( H\text{-Anim} \) \( \rightarrow \) SEDRIS \( \rightarrow \) DRM [33]

Warren Macchi, Edward Sims \( \rightarrow \) SEDRIS \( \rightarrow \) VRML, X3D \( \rightarrow \) Web3D consortium \( \rightarrow \) H-Anim [33].

As a result, SEDRIS \( \rightarrow \) VRML, X3D, H-Anim \( \rightarrow \) SEDRIS. SEDRIS \( \rightarrow \) VRML, X3D, H-Anim \( \rightarrow \) DRM.

Fig 8. SEDRIS \( \rightarrow \) H-Anim \( \rightarrow \) SEDRIS. SEDRIS \( \rightarrow \) H-Anim \( \rightarrow \) SEDRIS.
2.3.3. SEDRIS 3D [1]


Fig 9. SEDRIS 3D Studio Max 3D [22].

Fig 9. 3DS Max - SEDRIS [21]
2.4. SEDRIS

SEDRIS [45], a software package for the analysis of spatial data, includes a set of features that implement a flexible (meta) geometric feature model [45]. This model allows for the representation of complex geometries and their relationships. SEDRIS provides an API that enables the integration of spatial data analysis into other applications [11].

SEDRIS includes a grammar [45], a vocabulary, and a semantics [45] for describing spatial relationships. SEDRIS also includes an interface specification and a transmittal format.

- **SEDRIS API**
  1. **DRM** (Data Representation Model)
  2. **EDCS** (Environmental Data Coding Specification)
  3. **SRM** (Spatial Reference Model)

- **SEDRIS Transmittal Format**
  4. **API** (SEDRIS Interface Specification)
  5. **STF** (SEDRIS Transmittal Format)
Fig 10. SEDRIS (environmental data source), EDCS (representation), DRM (interchange), SRM (synthetic environment).

Fig 11. SEDRIS, EDCS, DRM, SRM. SEDRIS is an environment for data interchange. EDCS, DRM, and SRM are associated with SEDRIS. SEDRIS provides an environment for interchange, EDCS provides an environment for representation, and SRM provides an environment for SRM.

Fig 12. SEDRIS, EDCS, DRM, SRM. SEDRIS is an environment for data interchange. EDCS, DRM, and SRM are associated with SEDRIS. SEDRIS provides an environment for interchange, EDCS provides an environment for representation, and SRM provides an environment for SRM.

Fig 13. SEDRIS, EDCS, DRM, SRM. SEDRIS is an environment for data interchange. EDCS, DRM, and SRM are associated with SEDRIS. SEDRIS provides an environment for interchange, EDCS provides an environment for representation, and SRM provides an environment for SRM.
Fig 10. SEDRIS [8]
Fig 11. မိမိပြန့်စိုးသည် (representation) သို့မဟုတ် စွမ်းစွာအလွန်ပျံ့မှု
Fig 12.  

34
Fig 13.
2.4.1. DRM (Digital Rights Management)

DRM[1] is a set of technologies and practices used to protect intellectual property, typically digital content such as music, films, and software. DRM is used to control access to content and to prevent unauthorized copying, distribution, and circumvention of protection mechanisms.

There are various types of DRM technologies, such as encryption, watermarking, and access control mechanisms. DRM can be applied at different layers, including the syntax, semantics, and grammar of the content. DRM is often used in the context of data models to ensure that content is used as intended by the creator or publisher.

Table 2.1 shows an example of how DRM can be applied to different fields such as publishing, music, and software. The table highlights the challenges and solutions associated with each field.

<table>
<thead>
<tr>
<th>Field</th>
<th>DRM Type</th>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing</td>
<td>Encryption, Watermarking</td>
<td>Protecting proprietary content, unauthorized copying &amp; distribution</td>
<td>Use of watermarks, access control mechanisms, encryption</td>
</tr>
<tr>
<td>Music</td>
<td>Encryption, Access Control</td>
<td>Preventing unauthorized copying, distribution</td>
<td>Access control mechanisms, encryption</td>
</tr>
<tr>
<td>Software</td>
<td>Encryption, Access Control</td>
<td>Preventing unauthorized copying, distribution</td>
<td>Access control mechanisms, encryption</td>
</tr>
</tbody>
</table>

In summary, DRM is a crucial tool for protecting intellectual property in the digital age. It is used to ensure that content is used as intended by the creator or publisher, and it plays a significant role in the protection of digital content.
SEDRI$\cdots$ and SEDRI$\cdots$ and SEDRI$\cdots$. Table 2.$\cdots$ Table 3.$\cdots$  

<Geometry>, $\cdots$ Classification Data> $\cdots$ $\cdots$. Property> $\cdots$ $\cdots$.  

Fig 14.$\cdots$ Fig 15.$\cdots$
Table 2.

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Classification Data</th>
<th>Property Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>(vehicle)=(car)</td>
<td>(type)=(model)</td>
</tr>
<tr>
<td>width</td>
<td></td>
<td>(weight)</td>
</tr>
<tr>
<td>height</td>
<td></td>
<td>(year)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(fuel expense)</td>
</tr>
</tbody>
</table>

Table 3.
Fig 14. [Diagram]

Fig 15. [Diagram]

[56]

- (class)

- (relationship)


1) (association): DRM are used to define the relationships between different objects or entities. These relationships are used to model the interactions between objects or entities. The relationships can be classified into different types, such as association, aggregation, and generalization.

2) (generalization): Class diagrams are used to model the relationships between classes. These relationships can be classified into different types, such as is-a, kind-of, and has-a. The is-a relationship indicates that one class is a subtype of another class, while the kind-of relationship indicates that one class is a supertype of another class. The has-a relationship indicates that a class has a property or operation.

40
3) **aggregation**: In object-oriented modeling, aggregation is a relationship where an object has-a relationship with another object. The whole object (Class B) has multiple instances of another object (Class A) as its parts. In UML notation, aggregation is represented by a solid line with a diamond symbol at the end indicating the whole-part relationship.

In the diagram:
- Class A is aggregated by Class B.
- Class A is part of Class B.
- Class B has instances of Class A.

2003年 SEDRIS 3.1.2 介绍了 DRM (geometric), DRM (feature), DRM (data tables), DRM (topology), 327页的更多具体细节。

DRM (Rational) UML (Unified Modeling Language) 统一建模语言, 提供了 detail、detail、detail、detail、detail、detail。Fig 16, UML 统一建模语言, DRM 模型, 具体细节。
2.4.2. Zone Encoding Dictionary (EDCS)

DRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG. EDCS includes DRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG.

EDCSDRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG. EDCS includes DRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG.

Table 4. EDCS includes DRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG.

EDCSDRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG. EDCS includes DRM, EC, EA, EM, EE, EU, EQ, ES, EO, EG.
<table>
<thead>
<tr>
<th>What is it?</th>
<th>How is the object characterized?</th>
<th>How is the object measured?</th>
</tr>
</thead>
<tbody>
<tr>
<td>classifications</td>
<td>attributes</td>
<td>units of measure &amp; scales</td>
</tr>
<tr>
<td>building</td>
<td>with the function of a lighthouse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>whose height</td>
<td>is 3.05 decametres.</td>
</tr>
<tr>
<td>river stream</td>
<td>whose speed</td>
<td>is 1.5 metres per second.</td>
</tr>
<tr>
<td>ocean floor</td>
<td>which is composed of coral</td>
<td>is 0.97 kilograms per cubic decimetre.</td>
</tr>
</tbody>
</table>

*Table 4. EDCS [56]*
2.4.3. རྣ་དིང་ཤེས་(SRM)

DRM རྣ་དིང་ཤེས་EDCS རྣ་དིང་ཤེས་ཤུན་བཞི་བཟོད་དེ་ཡིན་གཅིག་ནི་འེང་འི་པོ་ཆེན་མི་ས་སུ་ཞེ་སོར་གྱི་ཤེས་རིང་སོང་ཤེས་གང་ཤིན་།.

ཅིག་དང་ཤེས་ཤུ་རྣོ་རྗོང་ རྣ་དིང་ཤེས་SRM རྣ་དིང་2003 དེ་4 སྐད་ SEDRIS 3.1.2 པ།

SRM རྣ་དིང་151 ཚད་ཤུན་དེ་ཡིན་གཅིག་ནི་འེང་འི་པོ་ཆེན་མི་ས་སུ་ཞེ་སོར་གྱི་ཤེས་རིང་སོང་ཤེས་གང་ཤིན་།.

SRM རྣ་དིང་CADC རྣ་དིང་ཤུན་དེ་ཡིན་གཅིག་ནི་འེང་འི་པོ་ཆེན་མི་ས་སུ་ཞེ་སོར་གྱི་ཤེས་རིང་སོང་ཤེས་གང་ཤིན་།.

SRF (Spatial Reference Frames)

= CS (Coordinate System) + ORM (Object Reference Model)
2.4.4. SEDRIS (API)

SEDRIS supports DRM, EDCS, SRM interfaces in various programming languages. SEDRIS API supports DRM, EDCS, SRM interfaces in various programming languages. SEDRIS API supports DRM, EDCS, SRM interfaces in various programming languages. SEDRIS API supports DRM, EDCS, SRM interfaces in various programming languages.

C API supports various languages, such as C++, Java, etc. SEDRIS API supports (read), (write), (Level 0), (Level 1), etc., 4-level SEDRIS API.

Fig 17. 4-level SEDRIS API supports various languages.
Fig 17. SEDRIS API
2.4.5. SEDRIS API (STF)

DRM, EDCS, SRM API are used for STF. SEDRIS API is used for STF.

Fig 18: SEDRIS API is used for STF. SEDRIS API is used for STF.
Fig 18. STF [21]
3. 3.1. Deneb® Dassault Systemes®

DELMA [49], SEDRIS® [55] Technomatix®

UGS PLM Solutions® e-Factory [50] DELMIA®

DELMA (module) SEDRIS®

DELMA (process) Envision® IGIP® OLP®

Table 5: DELMA Envision® IGIP® OLP®
<table>
<thead>
<tr>
<th>Issue Area</th>
<th>DELMIA Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Planning, Detailing &amp; Validation Solutions</td>
<td>DELMIA Process Engineer</td>
</tr>
<tr>
<td></td>
<td>DELMIA Industrial Engineer</td>
</tr>
<tr>
<td></td>
<td>DELMIA DPM Assembly</td>
</tr>
<tr>
<td></td>
<td>DELMIA DPM Envision Assembly</td>
</tr>
<tr>
<td></td>
<td>DELMIA DPM Body in White</td>
</tr>
<tr>
<td></td>
<td>DELMIA DPM Powertrain</td>
</tr>
<tr>
<td></td>
<td>DELMIA DPM Shop</td>
</tr>
<tr>
<td>Resource Modeling &amp; Simulation Solutions</td>
<td>DELMIA Human</td>
</tr>
<tr>
<td></td>
<td>DELMIA Envision Ergo</td>
</tr>
<tr>
<td></td>
<td>DELMIA IGrip</td>
</tr>
<tr>
<td></td>
<td>DELMIA ULTRAs (UltraArc / UltraSpot / UltraPaint)</td>
</tr>
<tr>
<td></td>
<td>DELMIA Cell Control</td>
</tr>
<tr>
<td></td>
<td>DELMIA Robotics</td>
</tr>
<tr>
<td></td>
<td>DELMIA Virtual NC</td>
</tr>
<tr>
<td></td>
<td>DELMIA Inspect</td>
</tr>
<tr>
<td></td>
<td>DELMIA Quest / DELMIA Quest Express</td>
</tr>
</tbody>
</table>

**Table 5. DELMIA Solutions**

51
3.2. Ottawa Jauvane Jauvane 3 (Collaborative Virtual Environment) (Collaborative Virtual Environment) [36].

- DIVE (Distributed Interactive Virtual Environment)
  Swedish Institute of Computer Science
- COVEN (COLlaborative Virtual ENvironments)
  Thomson- CSF Laboratoire Central De Recherches, France
  and Department of Computer Science, University of Nottingham, UK
- CAVERN (CAVE Research Network)
  Electronic Visualization Laboratory, University of Illinois at Chicago

Living Worlds (LW), Open Community (OC), High Level Architecture (HLA), Java Shared Data Toolkit (JSDT) (delay) (delay) (delay).

Scene Graph (SGI(Silicon Graphics, Inc.))] Scene Graph VRML, X3D Web3D.
Multigen-Paradigm  and  OpenFlight[53].  In  fact,  STEP  is  the  standard  for  exchanging  CAD,  PDM  and  other  data.

CAD  [23].  The  process  of  producing  CAD  data  is  often  complex  and  requires  specialized  tools.

DELMI A  PPR  Hub[49].  PPR  Hub[49]  integrates  Product,  Process,  Resource  data  into  a  single  database.  This  integration  is  crucial  for  efficient  management  of  product  development.

PPR  Hub[49]  provides  a  comprehensive  view  of  the  product  lifecycle  from  design  to  manufacturing.  Table  6.  NURBS[49]  is  a  type  of  surface  representation  used  in  CAD  systems.
<table>
<thead>
<tr>
<th></th>
<th>Etc.</th>
<th>Database</th>
<th>Modeling &amp; Simulation</th>
<th>NURBS</th>
<th>VRML, X3D</th>
<th>PPR Hub</th>
<th>SEDRIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELMIA</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
</tr>
<tr>
<td>OpenFlight</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
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<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
</tr>
<tr>
<td>SEDRIS</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
<td>⭐️</td>
</tr>
</tbody>
</table>

Table 6. SEDRIS
3.3. DELMIA

DELMIA is a versatile software that can be adapted to various manufacturing environments. It is often used for tasks such as design, simulation, and production.

DELMA offers a wide range of features, including 3D CAD, simulation, and manufacturing support. It is used in industries such as automotive, aerospace, and heavy machinery.

DELMIA Envision is a part of the DELMIA suite that allows for the creation and management of 3D models. It supports various data formats such as ASCII and reverse engineering.

DELMIA supports a variety of file formats, including 3D CAD, 3D Scan, 3D CAM, 3D Print, and 3D Model. It also supports various file types such as .ipt, .ipts, .iptb, and .ipts.

1) 3D CAD: DELMIA supports various 3D CAD formats such as .ipt, .ipts, .iptb, and .ipts.

2) 3D Scan: DELMIA supports various 3D Scan formats such as .ipt, .ipts, .iptb, and .ipts.

3) 3D Print: DELMIA supports various 3D Print formats such as .ipt, .ipts, .iptb, and .ipts.

55
3.3.1. (part)

DELMIA Envision®  DELMIA Envision®  DELMIA Envision®. DELMIA Envision®  DELMIA Envision®. DELMIA Envision®  DELMIA Envision®.

Fig 19. a) DELMIA Envision® 'mill.0' (line)  DELMIA Envision®

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>6</td>
</tr>
</tbody>
</table>

DELMIA Envision®  DELMIA Envision®  DELMIA Envision®  DELMIA Envision®  DELMIA Envision®  DELMIA Envision®  DELMIA Envision®

NURBS®  NURBS® (curve)  NURBS®  NURBS® (curved surface)  NURBS® (polygon)  NURBS®  NURBS® (line)  NURBS®  NURBS® (face)

NURBS®  NURBS®  NURBS®  NURBS®  NURBS®  NURBS®  NURBS®  NURBS®

NURBS® (tessellation)  DELMIA Envision®  DELMIA Envision®  DELMIA Envision®

56
Fig 19. ‘mill.0’ (DELMIA Envision)
SEDRIS® NURBS® ISO- 10303 STEP(Standard for the Exchange of Product model data) AIC(Application Interpreted Constructs) 500[3] [57].

POLYGON #1

<table>
<thead>
<tr>
<th>22:</th>
<th>-2</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>23:</th>
<th>12</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>24:</th>
<th>177.800003 1778.000122 2082.800049</th>
</tr>
</thead>
<tbody>
<tr>
<td>35:</td>
<td>153.979324 1866.900146 2082.800049</td>
</tr>
</tbody>
</table>

36: 0
37: 2

38: 12 0 1 2 3 4 5 6 7 8 9 10 11
39: 12 0 11 10 9 8 7 6 5 4 3 2 1

POLYGON #1

POLYGON #1

POLYGON #1

Fig 19
3.3.2. (device)

DELMIA Envision® and SDRIS® are shown in Fig. 20. 'v800' (clamp) is DELMIA Envision® and 'v800' (device) is SDRIS®.

1: 12

Clamp_user

<Model> name (field) in SDRIS DRM

<Classification Data>

6: 1

(DOF:Degree of Freedom)
Fig 20. ‘v800’ ﻮ٣ ﺚ٤ ﺙ٤ ﺮ٣ ﺖ٣ (DELMIA Envision)
46: Move_By_Links

... (kinematics type)[].. kin._[].. kin_numeric[]. SEDRIS[]. Move_By_Links[],... kin travel limit[].. upper limit[].. lower limit[].

PART #1

175: 1 0 0 0
176: 0 1 0 0
177: 0 0 1 0
178: 0 0 0 1
179: USRMNL/v800.0

PART #1 USRMNL "v800.0 (reference)", SEDRIS, ITR (Inter-Transmittal Referencing).

194: 1

PART #4

269: 001

PART #4 "v800" 001, 2, 001 1 PART #4

PART #1 ~ PART #6 "v800" 001, 2, 001 1 (lever)

v800.0 ~ v800.1
v800.4 ~ v800.5
v800.2 ~ v800.3
Fig 21. 'v800' 🌒 🌞 🌌 🌑 🌒 🌓 🌔 🌕 🌖

64
3.3.3. োো (workcell)


<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1:</td>
<td>14 DENEB_WORKCELL_FILE</td>
</tr>
<tr>
<td>2:</td>
<td>User: DELMIA Corporation</td>
</tr>
<tr>
<td>3:</td>
<td>Time: 12:20 PM</td>
</tr>
<tr>
<td>4:</td>
<td>Date: Friday 4 August 2000</td>
</tr>
</tbody>
</table>

োো স্থানে আছে যা, যৎ, যা োো োো কাজের সূচনায় উল্লেখ করা হয়েছে। SEDRIS DRM[2] শীর্ষে োো<Access>,<Citation>,<Description>,<Point of Contact>,<Base Time Data> শীর্ষে োো কাজের সূচনায় উল্লেখ করা হয়েছে।

| 20: | 6 |

োো স্থানে আছে যা, যা োো োো কাজের সূচনায় উল্লেখ করা হয়েছে। শীর্ষে োো োো কাজের সূচনায় উল্লেখ করা হয়েছে।

| 21: | **BEGIN_DEVICES** |

োো স্থানে আছে যা পিন্ন, যা োো কাজের সূচনায় উল্লেখ করা হয়েছে। োো কাজের সূচনায় উল্লেখ করা হয়েছে।
Fig 22. 'pcar.weld' (DELMIA Envision)
DEVICE #1

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22:</td>
<td>DENEBOTS/DB500</td>
</tr>
<tr>
<td>23:</td>
<td>12</td>
</tr>
<tr>
<td>24:</td>
<td>DB500#2</td>
</tr>
</tbody>
</table>

DEVICE #1 (12) Mb, 'DB500'. DEVICE #1 – DEVICE #6 (6) Mb, 'DB500' 2 Mb, (AGV: Automatic Guided Vehicle) 1 'pcar', 2 (weld gun) 2.

1914: **END_DEVICES**

WELD, SPOT, ARC, PAINT.
3.4. DELMIA SEDRIS

3.4.1.

SEDRIX DM SHEET 14 <Colour> <CH> SEDRIX [constraints] Fig 23.

<Colour> <Colour_Data> <abstract> <concrete>

Focus<Ch> SEDRIX Fig 23.

<LSR Location 3D>, <Vertex>, <Line, <Polygon> SEDRIX DRM Fig 23.

DELMIA SEDRIX Fig 23.
<table>
<thead>
<tr>
<th>DELMIA</th>
<th>SEDRIS DRM Class</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ⓝ (colour)</td>
<td>&lt;Colour Index&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ (vertex)</td>
<td>&lt;Vertex&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (vertex location)</td>
<td>&lt;LSR Location 3D&gt;</td>
<td>SRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (line)</td>
<td>&lt;Line&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (polygonal face)</td>
<td>&lt;Polygon&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>DEVICE &amp; WORKCELL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (hierarchy structure)</td>
<td>&lt;UOGH&gt;- Union of Geometry Hierarchy</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (transformation)</td>
<td>&lt;LSR Transformation&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (transform matrix)</td>
<td>&lt;Local 4x4&gt;</td>
<td>SRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ</td>
<td>&lt;Control Link&gt;</td>
<td>DRM</td>
</tr>
<tr>
<td>Ⓝ Ⓝ Ⓝ Ⓝ (reference)</td>
<td>&lt;GM1&gt;- Geometry Model Instance</td>
<td>ITR (Inter-Transmittal Referencing)</td>
</tr>
</tbody>
</table>

Table 7. DELMIA[,] SEDRIS[,] Mapping Document [ ]
Fig 23. DRM
3.4.2. 3.4.2.

...ITR(Inter-Transmittal Referencing)... <Model Library> ... <Model> ... <Geometry Model Instance> ...
<Union of Geometry Hierarchy>, <Local 4x4>...
<Rotation>, <Rotation Control Link> ...

DRM ... SEDRIS... STF... classification... time... spatial... LOD... hierarchy... state... perimeter...
... SEDRIS... constraints... <Transmittal Root>...
... SEDRIS... (syntax_checker, rules_checker)... SEDRIS... (STF)...
3.4.3. SEDRIS

SEDRIS ህ uart වැඩි කොටස් ලක්ෂණයන් පැමිණින් පුදක්වා දෙන වේ. SEDRIS DR නම් පැමිණින්Attribute Set Table Library, Colour Table Library, Data Table Library, Image Library, Model Library, Sound Library, Symbol Library පැමිණින් පුදක්වා දෙන වේ.

සිංහලේ නම් පැමිණින් Attribute Set Table Library, Colour Table Library, Data Table Library, Image Library, Model Library, Sound Library, Symbol Library පැමිණින් පුදක්වා දෙන වේ.
4. SEDRIS

SEDREIS DELMIA, DELMIA DELMIA DELMIA DELMIA DELMIA. SEDRIS DELMIA SEDRIS SEDRIS SEDRIS SEDRIS SEDRIS.

4.1. SEDRIS

SEDREIS DELMIA, DELMIA DELMIA DELMIA DELMIA DELMIA. SEDRIS DELMIA DELMIA DELMIA DELMIA DELMIA.

1) DELMIA &

● Dassault Systemes DELMIA DELMIA DELMIA

2) Mapping Document

● DELMIA DELMIA SEDRIS DELMIA DELMIA DELMIA (mapping)

● SEDRIS DRM, EDCS, SRM DELMIA

3) API, STF DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA

● SEDRIS DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA

4) SEDRIS DELMIA DELMIA (syntax_checker, rules_checker)

Fig 24. SEDRIS DELMIA DELMIA SEDRIS DELMIA DELMIA SEDRIS DELMIA DELMIA. Fig 25. SEDRIS DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA DELMIA.
Fig 24. SEDRIS

Fig 25. SEDRIS
4.2. 3D Modeling

1) 3D Modeling
   - 3D Model, Tool, Jig & Fixture, D/B

2) Kinematics
   - Forward / Inverse Kinematics, Signal

3) D/B
   - Signal, D/B

SEDRI, a CAD/CAM software, uses 1) 3D Modeling, 2) Kinematics, and 3) D/B. SEDRI is compatible with Dassault Systemes' DELMIA, allowing the design of 3D models and the integration of signals within the D/B. SEDRI provides a comprehensive solution for these processes.
4.3. 间距 间距 间距 间距

1) 间距 间距
   • Microsoft Windows xp

2) 间距 间距
   • Microsoft Visual C++ 6.0

3) 间距 间距 间距 间距
   • Dassault Systemes DELMIA VMAP version 5.3, Envision Module

4) SEDRIS 间距 间距
   • SEDRIS Standard Development Kit 3.1.2
   • AcuSoft Side-by-Side 2.5
   • SEDRIS Focus 0.5
   • EDCS Query Tool 0.5
   • model_viewer, syntax_checker, rules_checker

DELMIA 间距 间距 间距 间距 STF 间距 间距.

DELMIA 间距 间距 间距 间距 STF 间距 间距.

DELMIA 间距 间距 间距 间距 STF 间距 间距.

SEDRIS 间距 间距 间距 间距 STF 间距 间距.

SEDRIS 间距 间距 间距 间距 STF 间距 间距.

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Fig 26.
Fig 27. La interfaz de trabajo de SEDRIS permite una comunicación fluida entre las herramientas del entorno industrial. SEDRIS cuenta con herramientas como syntax_checker, rules_checker y STF, que facilitan el proceso de verificación de los modelos. SEDRIS Focus es una herramienta adicional que mejora la experiencia del usuario. SEDRIS también cuenta con OpenGL Model Viewer para la visualización de los modelos en 3D, y AcuSoft para el análisis de fluidos. Side-by-Side con Multigen-Paradigm y OpenFlight permite una importación de modelos desde otros entornos. SEDRIS Exporter permite guardar los modelos en diferentes formatos. Fig 27. 

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4.4.  

4.4.1.  

Fig 28. / Fig 19. ‘mill.0’ / ‘STF’ / AcuSoft  
Side-by-Side[58] /  

Side-by-Side]  SEDRIS  /  ‘landing_gear’  /  ‘STF’ /  
Side-by-Side[58]  /  ‘STF’  /  

Fig 29. / ‘mill’ / ‘landing_gear’  /  ‘STF’ /  
Side-by-Side[58]  /  ‘STF’  /  

Fig 28. 'mill.0' [Image] (Side-by-Side)
4.4.2. .null

null.

Fig 30. Fig 20.

‘v800’ null STF null Fig 31.

‘v800’ null SEDRIS OpenGL Model Viewer null Fig 31.
Fig 30. 'v800' imageView imageView (Side-by-Side)

Fig 31. 'v800' imageView imageView imageView (SEDRIS OpenGL Model Viewer)
Fig 32. Fig 33. Fig 34.
Fig 32. 'v800'  

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Fig 33. 'v800' (2)
Fig 34. DELMIA

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4.4.3.

Fig 35. Fig 22. ‘pcar.weld’ STF (Automatic Guided Vehicle) 2. ‘pcar’ (weld gun) 2.

Fig 36. Maya 3D Image Library. Maya SEDRIS image.

Fig 37. Maya 3D Image Library. Maya SEDRIS image.

Fig 38. EDCS (property) parsing. EDCS (parsing) image.
Fig 35. 'pcar.weld' (Side-by-Side)

37: Model MAYA_model_6
10: Image Library
  1: Image: Mayaimage1.rgb
  2: Image: Mayaimage1.rgb
11: Environment Root
  1: Union Of Geometry Hierarchy
    1: Union Of Geometry Hierarchy
    2: Union Of Geometry Hierarchy
  2: Spatial Domain

Fig 36. Maya Image Library
Fig 37. DELMIA

14. Model: EB500.6
15. Model: PCAR
1: Geometry Model
2: Classification Data: ECC_VEHICLE
   1: Property Value: EAC_VEHICLE_CAPACITY
   2: Property Value: EAC_USAGE
16. Model: agr

Fig 38. EDCS

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5. []

5.1. []

...DELMAI, SEDRIS, SEDRIS (semantic) SEDRIS, SEDRIS, SEDRIS, SEDRIS, SEDRIS, SEDRIS, SEDRIS...
5.2. ការប្រើប្រាស

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   http://www.eds.com/products/plmfactory/factory_products/cad.shtml
[53] OpenFlight, Multigen-Paradigm の の の ，
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1994.3 ~ 1996.2 : מעבר למתמטיקה
2002.9 ~ 2004.8 :  ):ה"עשתה המתמטיקה (M.E.)

2000.4 ~ 2002.6 :  ):ה"עשתה KATUSA

CAD/CAM בŐ