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AUTOLISP /ICES/CDF AND SDF Multilateral Communication Language between AUTOCAD and CAM Activities.

Tawfik El-Midany
Professor of Production Engineering Department., Faculty of Engineering., El-Mansoura University., Mansoura., Egypt.

M. El-Baz
Associate Lecturer., Higher Tech. Inst., Ten. Th. 06 Ramadan City, elbaza@mail2world.com

AUTOLISP/IGES/CDF AND SDF MULTILATERAL COMMUNICATION LANGUAGE BETWEEN AUTOCAD AND CAM ACTIVITIES

طرق الربط المختلفه بين الاوتوكـاد ومتطلبات الحاسب في التصنيع Autolisp / IGES / CDF and SDF

Tawfik T. El-Midany
Prof. of Prod. Engg.
Faculty of Engineering, Mansoura University
Mansoura - Egypt

M. Adel El-Baz
Assistant Lecturer
Higher Tech. Inst. - Tenth of Ramadan City

ملخص :

يعتمد نجاح استخدام الحاسب الالى فى تطبيقات التصميم والتصنيع على مدى توافر وسائل الربط المختلفه بين نظامى الكاد والكام . وفى بحث سابق تم توضيح اسلوب كيفيه تصميم برامج ماكينات التحكم الرقمى سواء بالنسبه لعمليات التفريز او الخراطه بطريقه مباشرة من نظام الكاد (الاوتوكاد) عن طريق استخدام ملف DXF . وفى هذا البحث يتم تناول كيفيه استخدام لغة Autolisp للتعامل مع الاوتوكاد لتطويع البيانات المخزنه فى الاوتوكاد وتكوينها بالشكل المطلوب لاعاده استخدامها فى تطبيقات التصنيع المختلفه وكذلك تم شرح الملف IGES والذى يستخدم لنفس الغرض وبالنسبه لتطبيقات التصنيع التى تحتاج الى حصر البيانات المختلفه مثل انواع المواد واسماء الاجزاء المختلفه وعدد كل منها والكود المختلفه لكل جزء او اى بيانات حصر اخرى تم توضيح كيفيه استخدام ملفى SDF/CDF الذين يمكن استخراجهما من نظام الاوتوكاد واعاده استخدامها مع برامج اخرى مثل dbase وقد تم الحصول على نتائج مرضيه تفيد فى تطبيقات الحاسب بالنسبه للتصميم والتصنيع .

ABSTRACT

Great benefits have been obtained from the fully integration between CAD systems with the other Computer-Aided Engineering CAE activities. NC programming for both milling and turning had been successfully demonstrated in previous work. These programs generate automatically the NC part program required for any specific product through the geometry data from the DXF file extracted from AUTOCAD. The work in hand focuses the possibility of retrieving CAD Drawing Data Base (DDB) through specific procedure, starting from AutoLisp program, IGES format and ending with both CDF and SDF files for managing the Manufacturing Data Base (MDB). Excellent results and benefits have been demonstrated.

1 INTRODUCTION

The integration of Computer-Aided Design (CAD) Systems with manufacturing activites provide industry with large economic and commerical benefits. Current practice has been to provide such integration by means of specific application programs [1]. Often these run on CAD system and simulate the relevant manufacturing process and once the results of the simulation are satisfactory, executable instructions for the real manufacturing system are generated and issued from the CAD system. Many programs written in this way require the user to retrieve the MDB from CAD system. The MDB includes all the data on the product generated during design such as; geometry data, bill of materials and parts list, material specifications, etc. as well as additional data required for manufacturing much of which is based on the product design. In a previous work [2 & 3] we had described how the user can use the geometry data from the DXF file extracted from AutoCAD to generate automatically the NC part program required to manufacture the part drawing for milling and turning operations. In this paper we look at the possibility of retrieving CAD drawing data base (DDB) by different ways. First an Autolisp program has been described, to extract DDB in a specified format then the IGES file format has been illustrated. Finally both CDF and files have been described using for managing the MDB.

2 MACRO AUTOLISP PROGRAM

AutoLisp is a form of Lisp programming language embedded within AutoCAD [4]. AutoLisp allows to write macro programs and functions that is well suited to graphics applications. The current program is to retrieve the drawing entities from the data base and returned as a list containing its definition data. Objects in the resulting list are coded with AutoCAD's DXF group codes [5] for each part of the entity data and list the results in a text Ascii file. The output format can be changed to suit a specfied application. Figure 1, illustrates the suggested program. Figure 2, illustrates the ouput of the drawing data base for the part drawing shown in Fig. 3. As shown in Fig. 2, the output of the first arc include its center (35.0,33.0), the radius which equal to 5.0 and both the start and end angles which equal to 3.14159 and 4.71239 respectively. The second entity "Line" represented by two points (35.0,30.0) and (75.0,30.0) respectively. The last entity "Circle" represented by the center (55.0,45.0) and its radius (10.0).

3 IGES

IGES, is another method to transfere data from a CAD system. IGES was originally published by the National Institute of standards and Technology (NIST) [6]. An Example of an IGES file is shown in Fig. 4, for the part drawing shown in Fig. 3. The command used to generate IGES file is IGESOUT. The IGES represtation is an Ascii text file composed of five major sections :

```
(defun c:a2 ()
(setq r (open "rb.txt" "w"))
(setq d (ssget))
(setq l 0 n (sslength d))
(while (< l n)
(setq f (cdr (assoc 0 (entget (ssname d l)))))
(setq x (cdr (assoc 10 (entget (ssname d l)))))
(setq y (cdr (assoc 11 (entget (ssname d l)))))
(setq c (cdr (assoc 40 (entget (ssname d l)))))
(setq s1 (cdr (assoc 50 (entget (ssname d l)))))
(setq s2 (cdr (assoc 51 (entget (ssname d l)))))
(print f r)
(print (car x) r)
(print (cadr x) r)
(print (car y) r)
(print (cadr y) r)
(print c r)
(print s1 r)
(print s2 r)
(setq l (+ 1 l))
)
(close r)
)
```

Fig.1 Macro Autolisp Program.

```
"ARC"
35.0
35.0
nil
nil
5.0
3.14159
4.71239
"LINE"
35.0
30.0
75.0
30.0
nil
nil
nil
"ARC"
75.0
35.0
nil
nil
5.0
4.71239
0.0
"LINE"
80.0
35.0
80.0
55.0
nil
nil
nil
"ARC"
75.0
55.0
nil
nil
5.0
0.0
1.5708
"LINE"
75.0
60.0
35.0
60.0
nil
nil
nil
"ARC"
35.0
55.0
nil
nil
5.0
1.5708
3.14159
"LINE"
30.0
55.0
30.0
35.0
nil
nil
nil
"CIRCLE"
55.0
45.0
nil
nil
10.0
nil
nil
```

Fig.2 Output of the Suggested Autolisp Program [illegible]

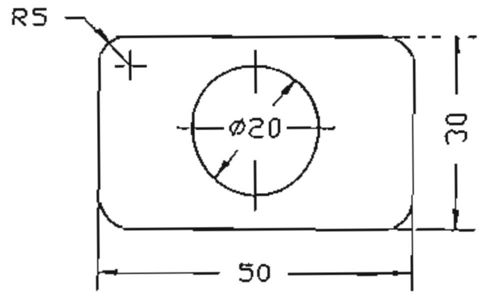


Fig.3 The Part Drawing.

```
IGES file generated from an AutoCAD drawing by the IGES                S0000001
translator from Autodesk, Inc., translator version IGESOUT-3.01.       S0000002
,,1Hq,5HQ.IGS,13HAutoCAD-10 c7,12HIGESOUT-3.01,16,38,6,99,15,1Hq,1.0,1, G0000001
4HINCH,32767,3.2767D1,13H920613.141016,1.0D-8,80.0,6HThroop,14HAutodesk,G0000002
 Inc.,4,0;                                                              G0000003
     100       1       1       1                       0       00000000D0000001
     100                       1                                       D0000002
     110       2       1       1                               00000000D0000003
     110                       1                                       D0000004
     100       3       1       1                       0       00000000D0000005
     100                       1                                       D0000006
     110       4       1       1                               00000000D0000007
     110                       1                                       D0000008
     100       5       1       1                       0       00000000D0000009
     100                       1                                       D0000010
     110       6       1       1                               00000000D0000011
     110                       1                                       D0000012
     100       7       1       1                       0       00000000D0000013
     100                       1                                       D0000014
     110       8       1       1                               00000000D0000015
     110                       1                                       D0000016
     100       9       1       1                       0       00000000D0000017
     100                       1                                       D0000018
100,0.0,35.0,35.0,30.0,35.0,35.0,30.0;                                1P0000001
110,35.0,30.0,0.0,75.0,30.0,0.0;                                      3P0000002
100,0.0,75.0,35.0,75.0,30.0,80.0,35.0;                                5P0000003
110,80.0,35.0,0.0,80.0,55.0,0.0;                                      7P0000004
100,0.0,75.0,55.0,80.0,55.0,75.0,60.0;                                9P0000005
110,75.0,60.0,0.0,35.0,60.0,0.0;                                     11P0000006
100,0.0,35.0,55.0,35.0,60.0,30.0,55.0;                               13P0000007
110,30.0,55.0,0.0,30.0,35.0,0.0;                                     15P0000008
100,0.0,55.0,45.0,65.0,45.0,65.0,45.0;                               17P0000009
S0000002G0000003D0000018P0000009                                        T0000001
```

Fig.4 Sample of an IGES File.

a-The start section, containing a human-readable header.
b-The global section, containing information about the CAD system where the drawing originated.
c-The directory entry section, which lists all entities (such as lines, circles, arcs and dimensions) and relationships that exist among them.
d-The parameter data section, which gives specific information about entities such as the starting and ending point of a line. For example the first line at this section display as:
100,0.0, 35.0,35.0, 30.0,35.0, 35.0,30.0, represent an arc its center point coordinate is (35.0, 30.0) and start point coordinate is(30.0,35.0) and end point coordinate is(35.0,30.0) The next line display as:
110, 35.0, 30.0, 0.0, 75.0,30.0, 0.0,represent a line from point (35.0,30.0) to point (75.0,30.0). The last line display as:
(100, 0.0, 55.0, 45.0, 65.0, 45.0, 65.0. 45.0;) represent a circle with center point coordinate (55.0,45.0) and a point (65.0,45.0)on its circumference.
e-The terminate section, containing a count of all lines that should be in each preceding section for data integrity purpose.

4 ATTRIBUTE EXTRACTION

Attribute extraction is a method to extract information entities from AutoCAD drawing and write them to a disk file for analysis by another program or for transfere to a data base. These data may include all the manufacturing data generated during design such as: material type, parts list, number off required, the part name code, the weight, material specifications,etc., and any other data used in management.

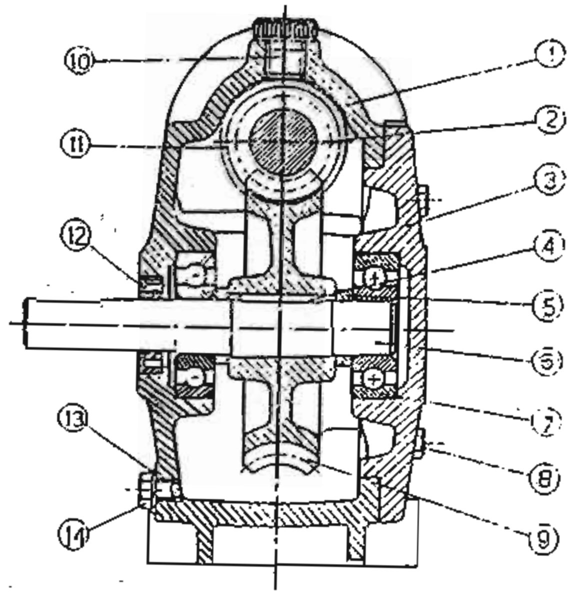
4-1 CDF and SDF Extract

The CDF and SDF format extraction processes are very similar [5]. Each write Attribute information to a text file in a format that can be read easily by dBASE package.

CDF: Comma delimited format. It produces a file containing at most one record for each block references in the drawing. The fields of each record are separated by a delimiter and character fields are enclosed in quotes.

SDF: At most one record is written for each block reference in the drawing. The fields of each record are of a fixed width, no fields separators or character string delimiteres are employed.

As an example of CDF and SDF format, Fig.5 illustrates the assemply drawing for a Worm Gear Box and its manufacture list defined as atribute including description (desc) of the parts, type of material (Mat), the number off required (Num).The code name (Code) and weight for each part may be added.The prompt sequence for Attribute definition and CDF,SDF extracts as follows:



DESC	NUM	MAT
BODY	1	GG.20
MORM	1	ST.60
COVER	2	GG.20
FEATHER	1	ST.50
DISTANCE WASHER	2	ST.37
SHAFT	1	ST.60
BALL BEARING	2	(15-4204)
SCREW M5x14	4	ST.40
WORM GEAR	1	ST.37
PLUG	1	BRASS
BALL BEARING	2	(12-4204)
PACKING	1	3
WASHER	1	CU
PLUG	1	ST.37

Fig.5 The Assembly Drawing of Worm Gear Box.

```
DESC C002000
MAT C004000
NUM N002000
CODE C008000
WEIGHT N003000
```

Fig.6 The Template File , Explain the Structure of the Extracted Files " Iclude Code and Weight if it added to the DDB "

```
'BODY', 1,'GG.20'
'WORM', 1,'ST.60'
'COVER', 2,'GG.20'
'FEATHER', 1,'ST.50'
'DISTANCE  WASHER', 2,'ST.37'
'SHAFT', 1,'ST.60'
'BALL BEARING', 2,'(15-4204)'
'SCREW M5x14', 4,'ST.40'
'WORM GEAR', 1,'ST.37'
'PLUG', 1,'BRASS'
'BALL BEARING', 2,'(12-4204)'
'PACKING', 1,'3'
'WASHER', 1,'CU'
'PLUG', 1,'ST.37'
```

Fig.7 The Extracted CDF File.

```
BODY                    1GG.20
WORM                    1ST.60
COVER                   2GG.20
FEATHER                 1ST.50
DISTANCE  WASHER        2ST.37
SHAFT                   1ST.60
BALL BEARING            2(15-4204)
SCREW M5x14             4ST.40
WORM GEAR               1ST.37
PLUG                    1BRASS
BALL BEARING            2(12-4204)
PACKING                 13
WASHER                  1CU
PLUG                    1ST.37
```

Fig.8 The Extracted SDF File.

Command: ATTDED
Attribute modes ... Invisible : N verify : N preset : N
Enter (ICVP) to change, Return when done : (Press Return)
The next prompt is :
Attribute tag : (Desc)
Attribute prompt : (Desc)
Default attribute value : (1)

Repeat a series of Attributes in the same way as text strings. For (Mat,Num,...etc). The second and subsequent Attributes in a series, simply enter a space or return when AutoCAD asks for the starting point. AutoCAD aligns each new Attribute Definition below the previous Attribute Definition, use Block Command to transfere the last attribute to a block and use insert Command to redefine a block when you need to add data to the manufacturing drawing.

To extract Attributes entity :
Command : ATTEXT
CDF,SDF or DXF Attribute extract(or Entities)?<C> (C.S or Return)

For CDF and SDF format extract, the next prompt is:
Template file (default): list (will be exploned)
Extract file name (drawing name): File Name
The extract file type is ".txt" for CDF or SDF format.

The template file tells AutoCAD how to structure the extract file; it specifies which Attributes are to be extracted. What information is to be included for each block having those Attributes, and how that information is to appear.

It created by using a text editor. Each line of the template file specifies one field to be written in the extract file. including the name of the field, its width in characters, and its numerical precision, if applicable.

Each record starts with the file name. Field name may be of any length. The next must be "C" or "N" denoting a character or numeric field. The next three digits are the field width in characters. The last three are number of decimal places for a numeric field.

Figure 6 , illustrates the template file (list.txt) used in the current example. Figures 7 and 8 , illustrate both the CDF and SDF extracted.

5 USING EXTRACTED FILES WITH dBASE BACKAGES

To impart the .txt files or .sdf files to dBase backages, first a data base file must be created with the same field charactristics at the extracted files, then the operation "Append from..... .txt delemited"for the .txt files and for sdf files"Append from...sdf"

CONCLUSION

A method of multilateral communication between different CAD/CAM drawing database has been devolped for the progress of CAD/CAM practice. A common language incorporated with the concept of common model has been introduced for the multilateral translation process. It has been shown that semantic analysis using the preliminary concept of set and relational theory is very useful. For this analysis, the essential and common structure of CAD/CAM drawing has been extracted and a sophisticated language to communicate between different CAD/CAM models has been integrated.

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