

GEOMETRY PARAMETRIZATION THROUGH OLE IN TURBOCAD SYSTEM

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1. INTRODUCTION

Main idea of the solution described in this paper is to create software product as design kit for parametric construction in woodworking machinery. General concept is based on OLE using, which is implemented in CAD system TurboCAD. This CAD system provides rich documentation about its Software Development Kit (SDK). Principally, TurboCAD has not parametric model using, it is using ACIS modeling engine. Our tool developed as separate application focus on to the furniture design manufactured from plate prefabricated semiproduct.

2. OLE – OBJECT LINKING AND EMBEDDING

Present Microsoft Windows operating systems (32-bit or 64-bit architecture, up-from MS Windows 98) provides interface called OLE (Object Linking and Embedding) for integration of various applications and for communication between they. This interface is based on object topology called client-server. An implementation of OLE request to create server in application, which will serve its own methods, objects and events, and on the other side, client application must to:

1. create connection from client to server,
2. implement algorithms for communication.

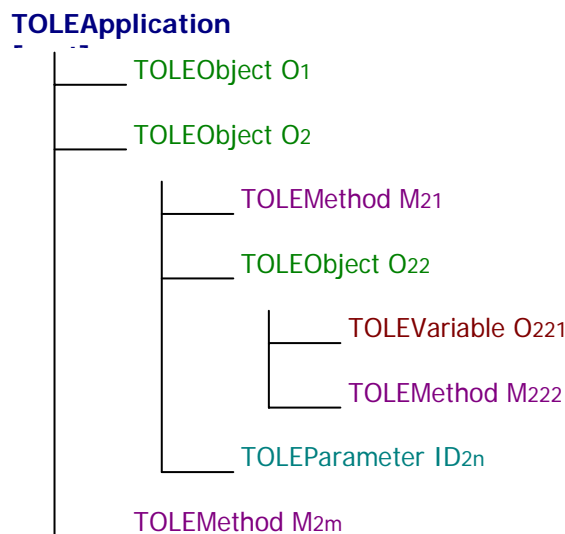


Fig.1 OLE object tree

In many case of OLE using the server and the client are placed on the same machine, but network implementation is also possible. Another very often used interface is COM (Component Object Modeling).

All OLE resources are derived from object hierarchy, where an TOLEApplication is parent for all others objects. Durign connection making is the virtual link to this OLE element created. Other handled resources are the part in object tree of this global OLE variable.

OLE interface is strictly object oriented (OOP – Object Oriented Programming) and also have three properties of OOP:

- inheritance,
- encapsulation,
- polymorphism.

3. TURBOCAD

TurboCAD is system for computer based design, manufactured by IMSI Inc., USA. It provides many tools for 2D and 3D geometry manipulation, number of export/import file formats, 2D plotting routines, macro recorder and OLE implementation called TurboCAD Software Development Kit (TCSDK). TurboCAD represent low-end system for Computer Aided Design (CAD). TurboCAD is released in two packages, first as pure TurboCAD with base tools and second, named TurboCADCAM, which contains CAM-plugin for basic machining performance in 2D and 2,5D milling, boring and lathing.

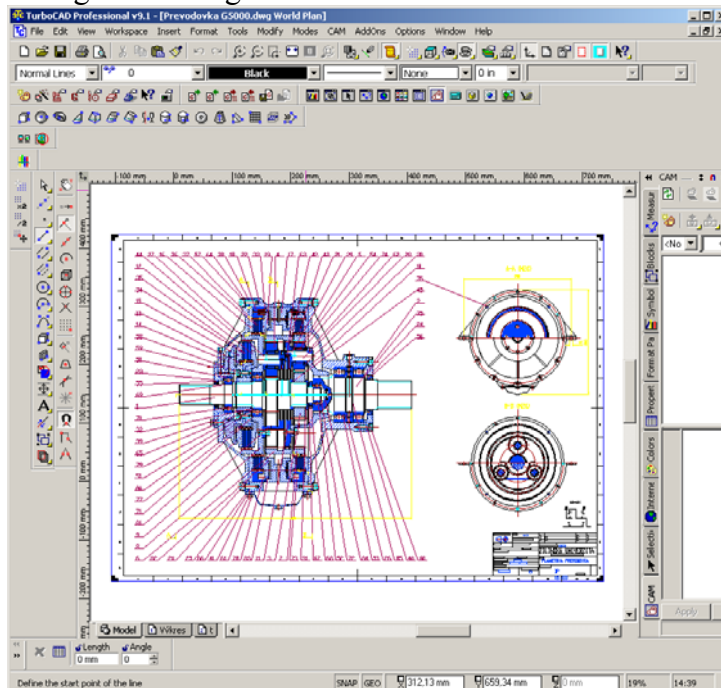


Fig. 2 TurboCAD screenshot

TurboCAD SDK is prepared for one (or all) of four programming languages:

1. C (Visual C#),
2. VisualBasic,
3. Java,
4. Object Pascal (Borland Delphi),

but (because it is based on the OLE environment) many other languages, which can to handle with OLE may to work fine with the system.

TurboCAD allow to create and build-in tools throught dynamic library (DLL file) development. OLE server implemented in TurboCAD serves these basic resources:

- objects,
- methods (for objects handling),
- events.

Essential object TOLEApplication represent virtual image of OLE server application (in our cause TurboCAD) and provides all served resources for outer application handling.

4. SOFTWARE SOLUTION

Because the target operating environment with OLE support is Microsoft Windows, our solution is also based on this system. We have to use Borland Delphi 7 Professional Edition IDE(Integrated Development Environment). This RAD (Rapid Application Development) tool encapsulate Object Pascal programming language, which is also object oriented. Second positive property is OLE application development support and also documentation for TurboCAD SDK describes using of Delphi IDE.

Our software solution must to do these few operation:

1. making connection with TurboCAD OLE server,
2. internal representation of TurboCAD model,
3. engine for 2D visualization (3D is very fine, but we do not have enough experience),
4. methods for: making joints between assembly parts, parameters handling, computing of positions and dimensions, update of model in TurboCAD through OLE.

4.1 Graphical and modeling engine

Visualization of handled object is based on Microsoft DirectX technology. For Delphi the component package DelphiX exists. This package provides few components for 2D, 3D graphics, sounds, keyboard and mouse input and others. Generally this technology was developed for easy computer games. In modern computer games is fast graphics needed and DirectX provides this kind of this problem solution. As we write in previous text, we will to use pure 2D graphics. For better development we utilize one of DelphiX component class called TDXDraw as the parent for new component TParCon, which is riched with basic 2D entities: lines, arcs, circles,

```
TParCon = class(TDXDraw)
private
  { Private declarations }
  ..
```

Fig. 3 TParCon object derivation

```
TItem = record { class of model }
  ID:integer;
  name:string[255];
  X1,Y1,Z1,X2,Y2,Z2:double;
  vlakna:word;
  a3D:array[0..2] of record { axis
properties, 0 = x, etc. }
  ConType:word;
  Val:double;
  DimN:string[255];
end;

TCon = record { joint class }
  iIDA,sIDA,iIDB,sIDB:integer; { parts
ID's in tree }
  ConType:word;
  Val:double;
  DimN:string[255];
  nast:Boolean;
  smer:word;
end;

TDim = record { dimension class }
  name:string[255];
  Val:double;
end;
```

Fig. 4 Basic object classes

text, rectangles, polylines, etc

In this paper is not enough space to describe all added features, and for this reason we will not to explain used drawing methods. These geometrical methods is based on standard analytic descriptive geometry in 2D and partially in 3D space. TParCon is an object class and contains (beside geometry algorithms and visualization methods) virtual model structures (Fig. 4).

4.2 OLE communication

The OLE communication has two important phases, the connecting and disconnecting. This is achieved by static procedures, which make an TOLEApplication object class TCAApp(Fig. 5). During this process next OLE variables/objects are derived from object tree of main parent (Fig. 1).

```

procedure Tmainfrm.Connect;
begin
  try

  TCAApp:=CreateOleObject('TurboCAD.Application.4'); { OLE call }
  TCDrws:=TCAApp.Drawings;
  TCDrw:=TCAApp.ActiveDrawing;
  TCGrs:=TCDrw.Graphics;
  except
  end;
end;

procedure Tmainfrm.DisConnect;
begin
  try
    VarClear(TCGrs);
    VarClear(TCDrw);
    VarClear(TCDrws);
    VarClear(TCAApp);
  except
  end;
end;

```

Fig. 5 Basic OLE communication

4.3 Virtual joints and dimensions

As we can see on fig.4, virtual model contains primitive (non-object) data structures, which store important information of inner structure of model (parts in assembly). Every part is on OLE environment of TurboCAD called as object of Tgraphics class (Fig. 6).

```

for i:=0 to TCGrs.Count-1 do { all TurboCAD Graphics objects cycle }
  begin
    TCGr:=TCGr.Item[i]; { assignment for concrete Graphics to handle }
    { another code for properties assignment }
    ..
  end;

```

Fig. 6 TurboCAD Graphics assignment

Every TurboCAD Graphics (TCGr) has number of properties and also its own objects hierarchy. Detailed view is described in TC SDK manual. These properties are during scanning routine assigned to data structure (dynamic array), vis. Fig. 4. Connection joints are made in three axis (in cartesian system), so inner dimensions of parts are in those. For example joint in x -axis can be placed onto left side of one graphics object and on right side of second. Common properties are ruled by type of joint:

1. static joint – this type have a solid dimension,
2. parametric joint – dimension of joint is given from table of dimension by name of dimension,
3. null joint – same as static, but with zero dimension.

Dimensions are structured in 2D table, where first column is assigned as name identifier of dimension and second describe value of real dimension. Third data record variable is inner dimensions of graphics. These entities laso have three type similar to joint kinds:

1. static dimension – solid dimension setting,
2. parametric dimension – dimension is given by table of dimensions,
3. free dimension – in this axis is object elastic.

5. FUNCTIONALITY OF SYSTEM

Work with kit begin by scanning command. During this routine, connection to TurboCAD (if is running) is made and also all graphics object are scanned and non-visual objects (cameras, lights, etc.) are separated from visuals.

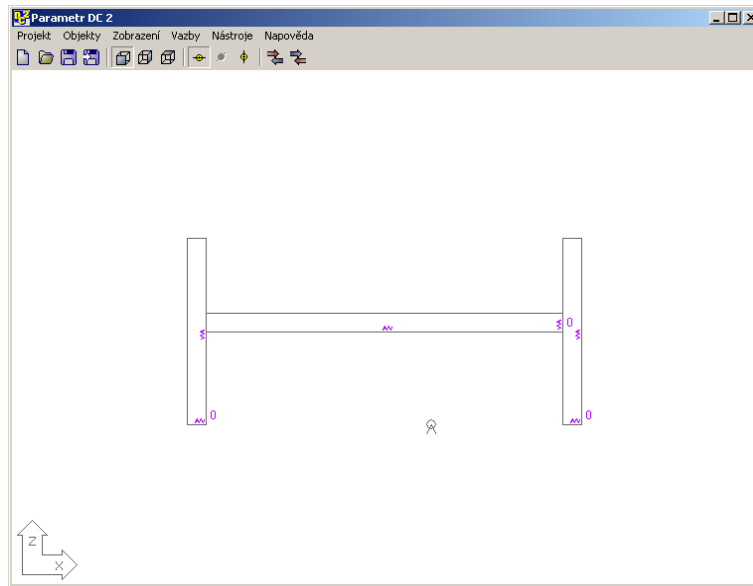
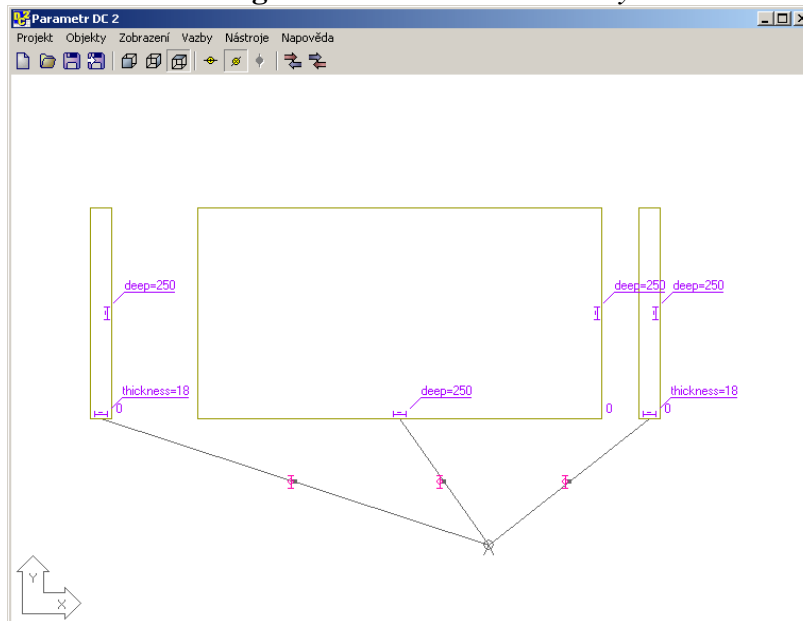


Fig. 7 Scanned objects

After objects scanning user can to perform table of parameters/dimensions:

Width	500
Height	300
Thickness	18
Height1	200
Deeep	250

Fig. 8 Joint and dimensions in y-axis



These basic parameters are assigned to the inner dimensions of objects.

After joints and dimensions making, the feedback communication with TurboCAD begins.

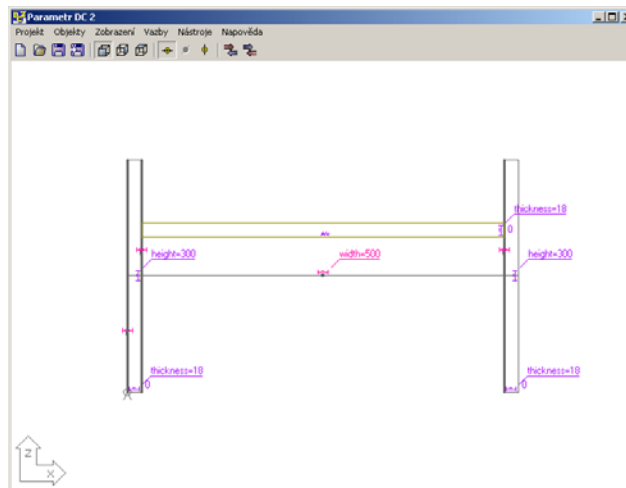


Fig. 9 Computed objects dimensions and positions

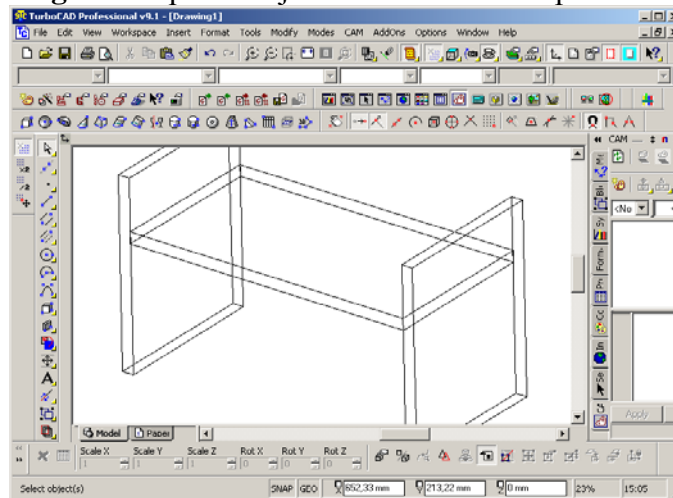


Fig. 10 Geometry after feedback in TurboCAD

6. CONCLUSION

In present, many science authorities, journals, CA systems developers and manufacturers highlights interoperability, communication and integration between CA systems and/or others expert oriented computer applications. And parametrization is also another centre of interest of modern production and computer science.

Solution described in this paper represent just very basic example of OLE implementation as of tool for software integration nad parametrization. Greater CA systems lika Pro/Engineer, CATIA and others provide possibilities for wider parametrization and integration. Social and economic aspect of automation in preparing phases of prduct lifecycle (time-to-market) also depend on these characteristic.

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