EVALUATION OF DRAWING PRECISION AND ITS CORRECTION

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Abstract. This paper deals with evaluation of 2D drawings precision and its correction with AutoCAD or Mechanical Desktop systems. If two-dimensional drawings are used for three-dimensional parameterized models design, in order to avoid profile adjustment over modeling process, two-dimensional drawing must be created precisely, according to all the requirements of projection drawing. However, sometimes we can find slight deviations from those requirements. An appropriate methodology and algorithm of the problem solution with AutoLISP programming language are presented. By employing this methodology graphical elements can be adjusted during the 2D drawing correction process. The profiles from 2D drawing can be used for 3D parametric objects creation without any interactive correction during modeling process.

Key Words: automated design systems, CAD/CAM/CAE, AutoLISP, projection drawing.

1. Introduction

Today many organizations have AutoCAD, one of most popular CAD software products in the world, developed and sold by AutoDesk Corporation. AutoCAD is the design and drafting software that allows customer to create a single drawing efficiently and deliver an entire set of coordinated drawings. Initially a general-purpose 2D drafting program, today AutoCAD is used by civil engineers, land developers, architects, mechanical engineers, interior designers and other design professionals.

AutoCAD's native file format, AutoCAD DWG, and to a lesser extent, its interchange file format, DXF, have become de facto standards for interchanging 2D CAD data. In 2006, AutoDesk estimated the number of active DWG files to be in excess of one billion. In the past, AutoDesk estimated the total number of DWG files in existence to be more than three billion.

Currently design organizations have stored multiple two-dimensional drawings with xxx.dwg format. According to current trends, CAD/CAM/CAE and high-end 3D hybrid systems requirements, a number of them will be transformed into three-dimensional parametric objects in a future. It is labor-intensive job with a huge human resources requirement [1, 2]. Organizations must employ new technologies for creating designs and completing the manufacturing process as well as get better products to market faster and at a lower cost.

If two-dimensional drawings are used for three-dimensional parameterized models design, in order to avoid profile adjustment over modeling process, two-dimensional drawing must be created precisely, according to all the requirements of projection drawing. However, sometimes we can find slight deviations from those requirements.

This article analyses questions related to 2D drawings precision and its automated correction with AutoCAD, AutoCAD Mechanical or Mechanical Desktop systems.

2. Appliance of Mechanical Desktop system inner graphical database in analyzing a drawn drawing.

Any two-dimensional drawing created in AutoCAD system is composed of separate graphical elements. Its geometrical description is saved by a special format of DXF codes

(Drawing Exchange Format). Analogous description of two-dimensional drawing format is applied for higher level system Mechanical Desktop (MD) that is why drawings created in AutoCAD system are completely readable. In reading a created drawing MD system formulates its own graphical database where geometrical description and systematic variables determined in a drawing of every graphical element of the drawing are submitted. Presently for each graphical element a peculiar name (valid only for one session) is endowed, decompounded from a combination of numbers and letters. An entire list of graphical element in the form of a list is provided for the created name. Using AutoLISP programming language it is possible to identify any graphical element in the database, determine its geometrical deviations and if necessary alter geometrical characteristics. This type of algorithm was used in designating projecting relation of graphical elements, correcting their geometrical characteristics.

Let us analyze all geometrical characteristics of a line respectively to projection drawing rules (Figure 1). The drawing presents three projections of a line (frontal, horizontal, and left side), coordinates of final points restricting a line, also their deviations in the frontal and left side projections. As the main view in all automated design systems is the view from the top (horizontal projection). A points coordinates in other projections are determined from the top view in worldwide coordinate system. It could be used for correction of two-dimensional drawing interactively. Having identified the basic point P0 (origin point of new coordinate system) of a curve diagram, a block with lines depicting the coordinate axis of the curve diagram could be inserted, and the drawing can be divided into quadrants. This operation permits to draw constructional lines automatically, which define projection connection to the defined geometrical element. Thus, it is possible to review the quality of the drawing visually.
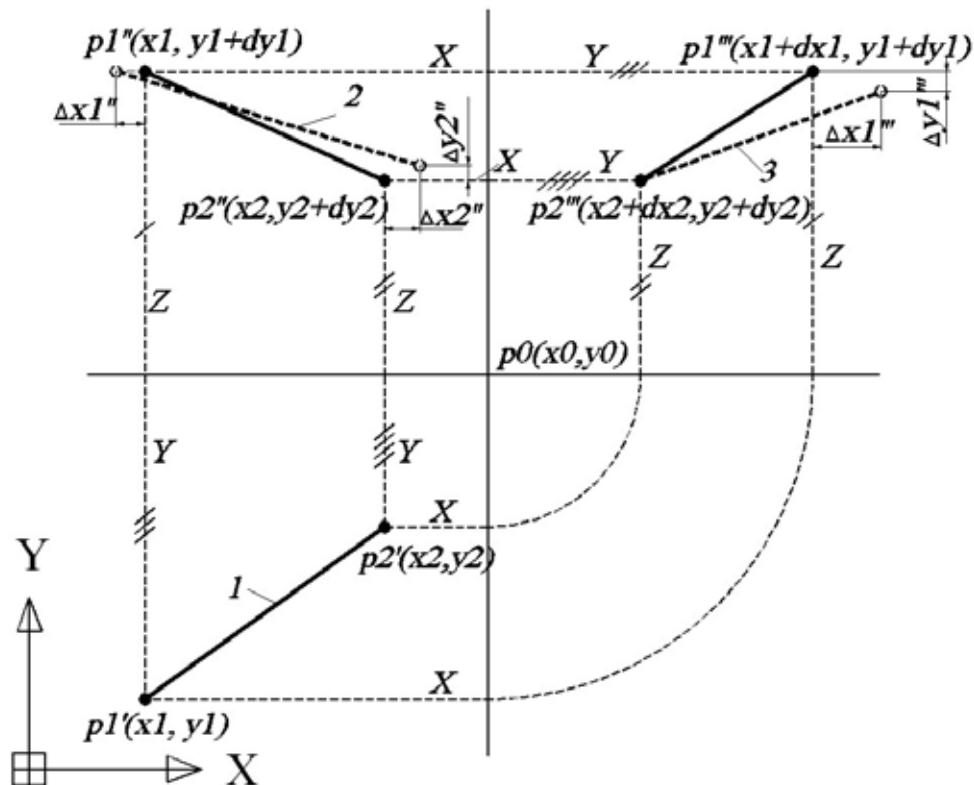

Figure 1: The position of coordinate of the line (point) with respect to the WCS

Analyzing the drawing which is represented in the Figure 1 we see that one of the coordinates' of the basic point P0 of a curve diagram could be chosen optionally (describing a

position of horizontal or vertical axis of a curve diagram among the images in the drawing), but the rest must be calculated using the presented formulas depending on the type of the defined axis:

$x0 = (x1 + dx1) - (y0 - y1);$ having marked horizontal axis of a curve diagram;

$y0 = (y1 + ((x1 + dx1) - x0));$ having marked vertical axis of a curve diagram.

Data for right sides of the equations are presented automatically using the created sub-program.

Algorithm of adjusting projection connection for the drawn graphical elements in three images is presented in the Figure 2. It is made according to the principle that the graphical elements on the drawing are adjusted respectively to the points in view of the first marked element. That element has to be adjusted given the deviation from the nominal meaning.
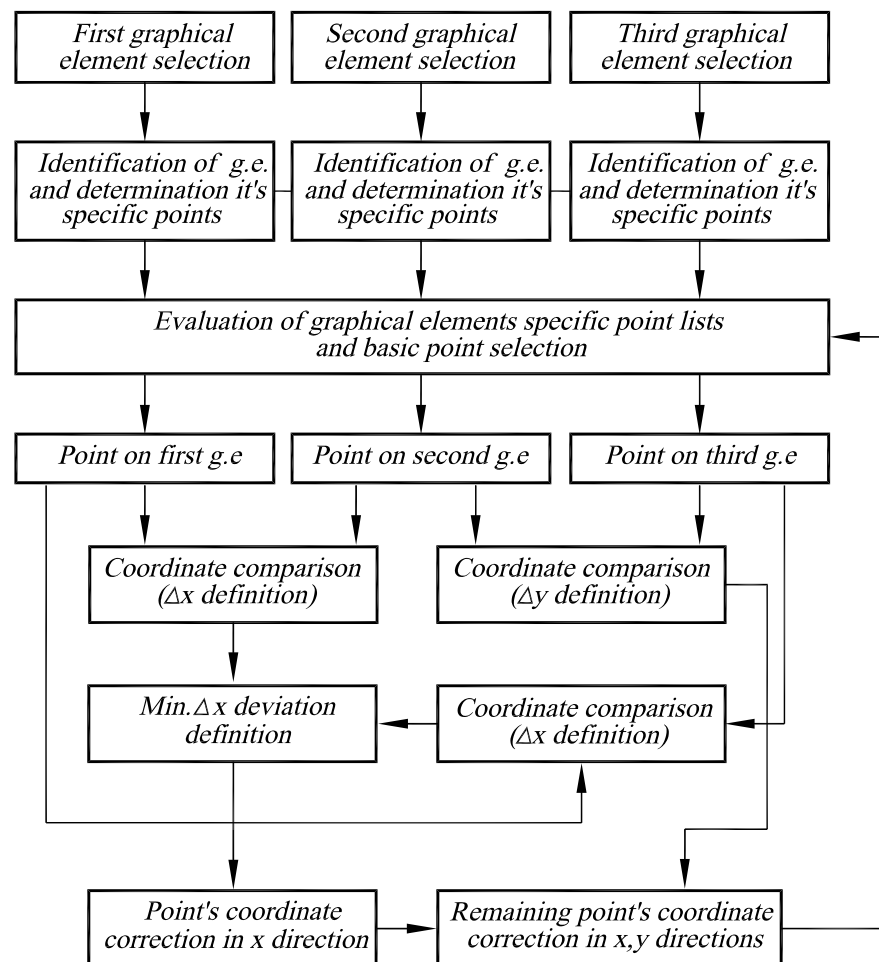

Figure 2: The algorithm of the graphical elements correction

Let us suppose that there is the line restricted by points p1' and p2' and it is being in the view from the top. In the case presented in the Figure 2, having marked the projections of a line in the view from the front or the left side, only the coordinates of the points restricting the line in the direction x are to be adjusted. In making a programming algorithm, attention should be put into the sizes of point projection deviation from theoretical nominal meaning restricting the graphical element. Figure 1 illustrates that the size of deviation in x direction respectively to the point p1' in the view from the front Δx1" is smaller than in the view from the left Δx1'". So according to the algorithm at first the point p1" should be corrected in the direction of smaller deviation (in the view form the front). The third projection of the point p1

in the view from the left is adjusted in two directions (x, y). The point p2 is adjusted with attention to the point on the left side view because the deviation Δx2'''of the point projection p2''' from the point of view of p2' equal to zero.

The analysis of parameters, program performing is executed by logical, programs' cycle organization functions [4].

Application of this methodology allows modification of the graphical element and drawing with an error. Therefore, while three-dimensional parametrical objects modeling process inside MD system, we will be able to create profiles of geometrical features (according to the methodology described in [1] literature) without interactive correction.

By employing that methodology, graphical elements can be adjusted during the process of creating a two-dimensional drawing. Due to that fact errors are avoided in the drawing.

3. Conclusions

1. By using the estimation criterions and methodology of the drawing in AutoCAD system, we can correct the errors of the projection in relation to the graphic element in the drawing.
2. The profiles from 2D drawings can be used for 3D parametric objects creation without any interactive correction during modeling process.
3. The methodology of the correcting graphic elements can be employed in 2D drawing creation process, and it accelerates design work.

References

[1] Nenorta V, Keršys R, Puodžiūnienė N, Pilkaitė T.: *Automated design subsystems creation for design works with Mechanical Destop software.* Engineering graphics BALTGRAF-7: (May 27-28, 2004 Vilnius, Lithuania): proceedings of he Seventh International Conference. Vilnius Gediminas Technical University, International Association BALTGRAF. Vilnius Technika, 2004, ISBN 9986-05-726-4, p. 81–87

[2] CAD/CAM/CAE observer. International analytic magazine. 2004-2005 Riga, Latvia, ISSN 14 7-7183.

[3] Autodesk. Mechanical Desktop 2006 User"s Guide. Autodesk, Inc. 2005, 764p.

[4] Čiuprinas V., Nenorta V.: *Grafinių vaizdų programavimas AutoLISP kalba.* Kaunas, Technologija, 2003, 88 p.

PROJEKTOWANIE LINII PROWADZĄCYCH O PROFILU KRZYWKI W SYSTEMIE MECHANICAL DESKTOP

W pracy tej przytoczone jest nietradycyjne formowanie trajektorii 3D „spline" w systemie Mechanical Desktop, wykorzystujące nasuwanie się wodzika w dwóch kierunkach graficznych. Sformuowana krzywa przestrzenna odpowiada trajektorii profilu krzywki. Może to być wykorzystane w wielu projektowanych systemach. Proponowany podsystem Mechanical Desktop daje możliwość praktycznego rozwiązywania specyficznych problemów technicznych przy wykorzystaniu graficzno – programowego modelowania.