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PROGRAM TO GENERATE EXPANSIONS OF SELECTED TYPES OF CONICAL AND CYLINDRICAL SURFACES

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A few years ago, at the Faculty of Energy and Environmental Engineering of the Silesian University of Technology, in the field of “environmental engineering”, the elective course of “Geometric CAD designing” has been cancelled. The proposal of the course was the result of the analysis of the designed solutions for the various types of installations and couplers [7]. The idea was to achieve two objectives. The first was to introduce students to the geometrically correct solutions, for example concerning pipelines to transport both gases and liquids, in particular elements such as couplers, elbows, T-connectors, etc.. The second objective was to teach students about the advanced methods of CAD designing.

At the field of “environmental engineering”, students had previously AutoCAD course. The course was carried out by the employees of the Faculty and included the basics of plane drawing, part of the groups also had the basics of 3D drawing in the scope of modelling. By joining the course of “geometric CAD designing”, students had to repeat and supplement the basics of geometry. The scope of new geometric issues was very large [3,4,5]. In the scope of AutoCAD, students had to get used to work in various UCSs (User Coordinate Systems). For people with not very developed spatial imagination, it initially constituted a big challenge [6]. It was assumed that students have to have such knowledge and skills so that they would cope with the constructing and preparing expansions using the capabilities of the program. The first three designs: the solution for a coupler – two prisms, a pyramid, a prism and a compensator (suitably shaped rotary cylinder) has taught how to use USC and how to rotate elements about different axes. Other designs, namely:

- the T-connector of three rotary cylinders with the same diameter, but the axes do not intersecting at one point,
- the T-connector circumscribed on a common sphere and composed of two cones and a cylinder
- the cable coupler with the circular cross-section and the rectangular cable.

Executing instructions repeated in these designs would be very tedious and brought nothing but greater efficiency in the manual manipulation of the mouse and keyboard shortcuts.

Therefore, an appropriate program to automate operations was developed. Development of the program required reconsidering the method of entering parameters necessary for the program to run and linking them with the process of acquiring the knowledge in the scope of the terminology used, the nature of expansions, etc. The program was written in AutoLisp [1,2] and it runs under AutoCAD.

Data for the program

In the case of the rotary cylindrical surface, in definitions there are terms such as axis of the sine wave, starting point of expansion, amplitude.

In the case of the cone they are: vertex, slant height, the shortest and longest slant height of cross section.

In the case of the non-rotating cone, the initially defined elements caused a lot of problems in students. In contrast to the rotary cylinder and cone, where the values are defined in a 2D drawing, for the non-rotating cone these parameters are given in 3D. This is due to the specific nature of that surface. A solution based on projections did not work in practice. Therefore, in the current version of the software there have to be selected a circle or its portion (circular arc) and a top of designed conical surface.

Assumptions of the program:

- simple method of entering parameters from the already prepared drawing in order to make an expansion
- capability to generate expansions at different section planes (not necessarily perpendicular to the projection plane)
- capability to match the accuracy of expansion by determining the amount of the divisions (the default value is division into 200 elements)
- in the case of the non-rotary cone, capability to generate its cross-sectional surface
- capability to decide on the place and direction of the implementation of the expansion

References:

- [1] Frenki D.: *AutoCAD. LSP i DCL. Programowanie okien dialogowych w przykładach*. Helion 2000
- [2] Horcyczak M., Skierski J.: *Autolisp dla użytkowników AutoCAD'a*, PLJ 1991
- [3] Polański S., Pianowski L.: *Rozwinięcia powierzchni w technice. Konstrukcje wspomagane komputerowo*. PWN, Warszawa 2001
- [4] Polański S.: *Rozwinięcia powierzchni*. PWN, Warszawa 1961
- [5] Polański S.: *Zastosowania rozwinięć powierzchni w technice*. PWN, Warszawa 1970
- [6] Sroka-Bizoń M., Terczyńska E., Tytkowski K.: *CAD geometric design*, Proceedings 23rd Conference Geometry Graphics Computer, 2016
- [7] Tytkowski K.: *Available pipe connectors versus their geometrical correctness*.-J. Biul. Pol. Soc. Geom. Eng. Graph. 2013 vol. 25, p. 67-72