THE PROPOSAL OF A SYSTEM FOR DETERMINING THE CHARACTERISTICS OF MODELED SURFACES

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The paper describes a methodology for determining the characteristics of the modeled surfaces in CAD systems. These characteristics are of major importance for development of process planning. These main characteristics can include surface dimensions, surface orientation and its type. The main role in determining the characteristics of areas is given to the design of a system for storing the CAD data which describe the surface. The file system format STEP AP214 will serve as input CAD data. The programming language C# 2008 will serve as a tool for CAD data processing using object-oriented programming principles. For storing CAD data will be used related database management system MySQL 5.3.

**Keywords:** CAD data, database system, normal vector, surface

Processing of CAD data takes place in stages. The aim is to obtain the necessary data and relations which are located between the entities. All data are stored in a relational database system which ensures the integrity of the original data and work with the information thus obtained is simpler and more flexible with regard to the use of SQL (Structured Query Language).

The file which is inserted into the system is not altered in any way. Thus, such data would be difficult to search and process. A new file which stores only data is the section in the DATA STEP file. The next phase is to find the rows that contain keywords and subsequent separation and collection of values that are in this line. An example is illustrated in Fig. 1. The method accepts one required input parameter and the text line which is located in the definition of a point in space.

```
public string[] cartesian_point(string input_text)
{
    char trichar = ' ';
    string temp_value;
    temp_value = input_text.Replace(";",";");
    temp_value = temp_value.Trim(trichar);
    string[] array = new string[4];
    array = temp_value.Split(';');
    string[] cartesian_point = new string[3];
    for(int i = 0;i<3;i++)
    {
        cartesian_point[i] = array[i+1];
    }
    return cartesian_point;
}
```

Figure 1 Example of separation and subsequent acquisition values
The proposal of a system for determining the characteristics of modeled surfaces

The most important task is to find values of the basis functions. The basis function is defined by (1) and (2).

\[ N_i^k(t) = \frac{u-t_i}{t_{i+k} - t_i} \cdot N_i^{k-1}(t) + \frac{t_{i+k+1} - u}{t_{i+k+1} - t_{i+1}} \cdot N_{i+1}^{k-1}(t), \]

(1)

\[ N_i^1(u) = \begin{cases} 1 & \text{if } t_i \leq u \leq t_{i+1}, \\ 0 & \text{otherwise} \end{cases} \]

(2)

To compute the basis functions a class called \( b\_\text{spline} \) is used which defines the method called \( \text{basis}\_\text{function} \). The basis functions are computed through cycles which are controlled by data from input STEP file. In this case can be seen the advantages of object oriented programming because the formula to compute derivative of basis function is similar to the formula to compute basis function and therefore the principle of heredity can be used.

4 Computation of the surface parameters

The coordinates of normal vector in any point of the surface present important information for each surface. B-spline normal vector is defined by (3).

\[ \vec{N} = \frac{dP}{du} \times \frac{dP}{dv} \]

(3)

Where \( dP/du \) and \( dP/dv \) are the tangents. The tangents are defined by (4) and (5).

\[ \frac{dP}{du} = \sum_{j=0}^{N} \sum_{i=0}^{M} P_{i,j} N_i^k(u) \frac{dN_j^k(v)}{du}, \]

(4)

\[ \frac{dP}{dv} = \sum_{j=0}^{N} \sum_{i=0}^{M} P_{i,j} N_j^k(v) \frac{dN_i^k(u)}{dv}. \]

(5)

Another important information is that about the points which are located in the surface. This point is defined by (6).

\[ P(u) = \sum_{j=0}^{N} \sum_{i=0}^{M} P_{i,j} N_i^k(u) N_j^k(v). \]

(6)

In Fig. 4 we can see the principle for calculating surface properties. Parameters \( P_{u,v}, P(u) \) and \( P(v) \) are obtained directly from the CAD data. \( N^u_i \) and \( N^v_j \) are the methods for computation surface basis functions. Next method is the method for computing the derivative of basis functions and the last method is used for tangent computation.
Using these three methods, we can calculate the normal vector. These methods must be used in a correct order. To calculate point coordinates we have to use only one method to compute the basis functions. Using this set of methods all properties of the surface are known. All methods are defined in a class called `b_spline`. A similar set of methods can be used for the Bézier surface or NURBS surface. However the formulas to compute surface properties will have to be modified.

5 Conclusion

The paper describes the system for determining the characteristics of the modeled surfaces in CAD systems. Information about surfaces is very important for CAPP systems. This solution can also be applied in features extraction from CAD data. With features extraction the entire model can be described. In data processing but also in determining the properties of surfaces the principles of object oriented programming are used. Advantage of this system is the independence of CAD systems, because it uses neutral format of data.

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6 References


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