Point-based, highly flexible landmark registration for (CAD) data transformation

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During the transfer and further processing of CAD data, the data transformation is decisive for the processing scope available later. With this transformation algorithm, objects are transformed point by point for the first time, enabling flexible and effective data processing, especially for additive manufacturing and reverse engineering.

- Highly flexible geometry transformation
- Increased utilization effectiveness
- No geometrical or topological restriction
- Grid-independent point positioning
- Local resolution can be manipulated
- Extendable to n-dimensional models
- Suitable for creating and analyzing shapes

Fields of application

Regardless of whether the CAD model data is based on a real-life model / scan or a computer model, fast data transformation is always crucial when data needs to be further edited by means of additional tools and applications. For example, this procedure allows very efficient reverse engineering.

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Service

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Background

Speed and accuracy required to ensure flexible and creative product development processes are limiting factors when collecting geometrical data to be transferred to a CAD model. However, the highly precise collection of data is not just a prerequisite for further processing. In the field of CAD, there has been a trend towards free-form design, which allows for free modelling of surfaces and edges by clicking an object at virtually any point of the geometry and distorting it as desired. This makes it easier to design organic shapes and stress- or flow-optimized components (e.g. in combination with FEM simulations and/or optimization procedures). Additive manufacturing processes support this trend as it allows users to create all kinds of shapes. Therefore, editability of data will become essential to ensure a high level of process quality.

Problem

The transformation process defines the type of grid or resolution to be applied to the points used for further editing. These transformation algorithms, such as free-form deformation methods (FFD), have so far been grid-based, which has a limiting effect on non-linear geometry adjustments. Adjusting such a grid to an object is often complicated and extremely time-consuming. In general, its transformation is only possible within defined limits, if at all. In most cases, the resolution selected is valid globally, which means important details cannot be provided easily with a higher local resolution.

Solution

Researchers at the University of Stuttgart succeeded in developing a novel transformation algorithm which allows for a point-based object transformation. In addition to two reference points, a freely selectable number of so-called landmark points is positioned strategically on an object – independently of the grid. Position-dependent control of the density of points allows for a higher level of resolution in strategic key areas. By moving the points, users can then evenly transform the underlying geometry. Not only the algorithm itself, but also its control by means of different geometry objects is unique.

This method can be used for both the creation and analysis of shapes. Based on a landmark registration, it is also possible to quantify proportions and perform a database-supported, fully automated analysis, including adjustments through comparison of reference data already stored in the database.

This method can also be used for n-dimensional, theoretical models. Thus, the system offers an unprecedented level of effectiveness in terms of geometrical and spatial data processing. It can be used for a wide range of applications in diverse fields – from individual prototype design to the automation of form generation processes.

So, there is nothing to stop highly flexible and effective processing of high-resolution, digital data in the future.