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ACTIVE SHAPE ANALYSIS IN SPACE

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The subject of this thesis is an introduction to studies on search for geometrical shapes in space and on methods for their recognition and record.

The aim of the hereinafter contained considerations is finding optimum solutions that will be useful for science and technology and possible to realize with the use of electronic equipment.

At first an attempt to explain the concept of shape has been presented. It is a very generic term which can be described in detail by use of many properties depending on the area of investigations. A question has been raised, what is the minimum number of dimensions used to describe a shape. Definitions of dimension and human intuition lead us to assumption that object having a shape and consequently a “zero” number of dimensions is excluded. This observation will serve during the search for the methods of shape recognition. The question has been raised, whether it is possible to describe in full the nature which we investigate merely with the use of mathematics. The principle of relativity of simultaneity from Albert Einstein’s special theory of relativity (STR) claims: “Two events happening in two different locations that occur simultaneously in the reference frame of one inertial observer, may occur non-simultaneously in the reference frame of another inertial observer”. It has been determined that we are perceiving a portion of the time and space only; moreover, the special relativity indicates that an assumption of an existence of a static set of points cannot be made. Personal recognition of space is not a real recognition of reality. All elements of the worlds are dynamic. Shapes that people see as defined solids are truly empty spaces covered with “points” in the form of atoms, which in turn are composed of smaller elementary particles, which in accordance with the uncertainty principle of Heisenberg cannot be precisely defined.

A shape can be described in a mathematical manner or by emotions. There are infinite ways to recognize one thing therefore the method of recognition should be matched to our use.

An attempt to systemize the methods for the recognition of shapes in three-dimensional space has been undertaken by assigning them to one of the two groups: methods based on a single overall reading and methods based on point by point reading. An overall reading, even though it can be precise in two dimensions, by the fact that it reads a flat picture provides an approximate depth of the reading which is dependent on the interpretation. Point by point measurements provide high precision in each of the dimensions however are associated with longer processing times and higher amounts of data. Example devices intended for scanning of objects in the space have been presented including devices analyzing curves from effect of grid projections and scanners such as the LIDAR.

During scanning the question of data acquisition and interpretation is of importance. Input data for 3D scanners is a cloud of points. Geodetics and cartography often require a faithful reproduction of certain shapes. Engineering and arts require a synthetic approach i.e. finding a function which describes the given shape.

A method for scanning of the space, referred to as “active analysis” has been proposed. In this method during the measurement of distances the data are concurrently processed to search for certain relationships and the subsequent measurements are adapted to the results of the analysis of the previous measurements. As an example a cross section which can be described by a function has served. A device takes several measurements based on which it determines the function. Next it continues the measurements until it reaches a point which does not belong to the given function. In this case the local measurements are iterated until the limit of the function is found. The arrangement of the measurement points on the object has been compared with the arrangement typically applied in the scanning of the space.

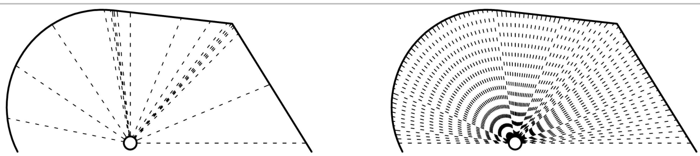

Fig. 1 Arrangement of distance measurements during active analysis(left) and typical scanning.

The way in which the device recognizes the space can be enhanced by various algorithms and rules, and adapted to any number of dimensions. It can be applied for tracking of various phenomena which can be described with the use of metric spaces. This gives potentially large possibilities for the development of the simple assumption.

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