ALGORITHM OF DETERMINATION OF SPACING INTERVAL UP TO OBJECT

Polad Heydarov

Institute of Cybernetics of ANAS, Baku, Azerbaijan, *plbaku08@rambler.ru*

In a number cases of problem solvings the determination of spacing interval up to object is required. In particular for problems of an engineering geodesy, at topographic filming, in military business (mainly for determination of spacing intervals up to the purposes), in navigating, in robotics, in astronomical researches, and also in problems bound with road and transport objects, where the precise and operating determination of spacing interval up to objects is necessary previously.

For this purpose for remote objects (spacing interval more than 1 km.) the successfully used radar systems of radiolocation, founded on a principle of calculus of spacing interval elapsed by radio signal from station up to object and back are known. The principles of radar systems are applied also with usage of other kinds of radiation: ultrasonic sound, laser radiation [1,2] etc., but the similar systems have the gentle parties, the limitations in particular have definite relation to a surface and stuff of mirrored object [1]. In this connection sometimes-even demand availability of the special reflector on object, up to which one it is required to determine spacing interval. Besides the constant simulated stimulus source is indispensable for similar systems, which creates the definite difficulties. For example coincidence a radiated frequency with other frequencies used in other systems, dispersion of a signal of radiation under certain conditions, not a capability of determination of the size of object and etc.

For the solution of the given problem the algorithm not of a radar principle of autodetection of spacing interval up to object, founded on a principle of determination of an image definition is offered, obtained through a moving lenticle concerning a screen.

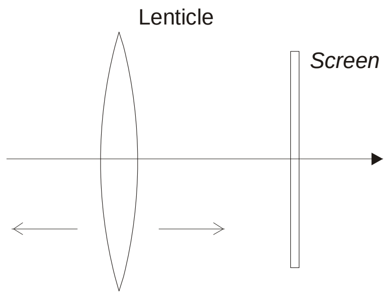

Fig. 1. Arrangements of a lenticle and screen

The principle of operation is consisted in following. There is a lenticle and screen allocated on one axis, as it is resulted in a fig. 1. Thus the lenticle goes in horizontal direction concerning a screen, sequentially coming nearer and leaving from a screen. On a screen the outcome refracted through a lenticle of the image is imaged. In a result in each discrete instant on a screen will be derivated the image, and in the total for a definite span the whole massif of the images. The algorithm of determination of spacing interval up to the image is consisted in following: definition most sharp images of object from all massif of the images.

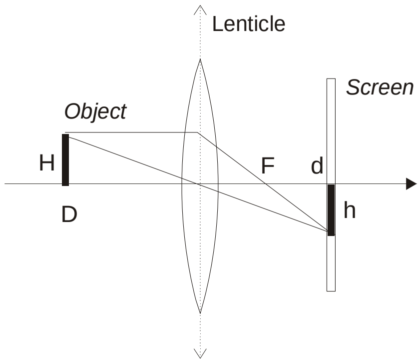

Fig. 2. Arrangement of object and image of object

It is possible to construct of a fig. 2 ratio:

$$\frac{H}{h} = \frac{F}{d_i - F}, \text{ and } \frac{H}{h} = \frac{D_i}{d_i} \tag{1}$$

From here

$$\frac{D_i}{d_i} = \frac{F}{d_i - F}$$

$$D_i = \frac{d_i F}{d_i - F} \tag{2}$$

Where D_i spacing intervals from object up to a lenticle, F is focal distance of a lenticle, d_i is spacing interval from a lenticle up to the image [3, 4].

Thus to each image there corresponds definite spacing interval d_i from a lenticle up to a screen, so also spacing interval D_i from a lenticle up to object, according to expression (2).

In tendered algorithm the image definition is determined on the basis of one or several lines of pixels (fig. 3). Thus each line of pixels is value of tints conforming colour. Each curve of tints of colours corresponds to one of colours: red, green, blue if this colour image or one curve in a black-and-white graphic pallet (fig. 3, 5).

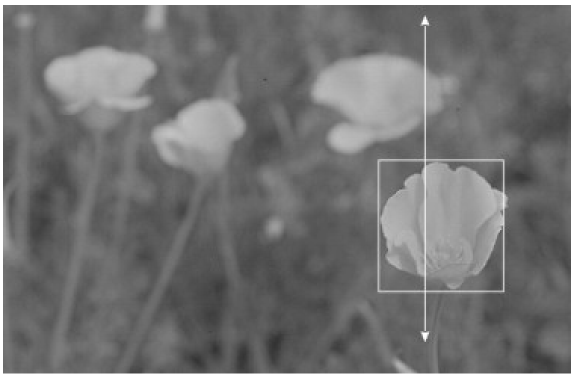

Fig. 3. Localization of object

In each of these curves the examination is executed for sharp transitions in colour tints. For this purpose the segmentation of curves is previously executed, according algorithm of a structural - segment method described in the article [5]. The outcome of similar segmentation is resulted in a fig. 4 for the indicated in a fig. 3 of a column.

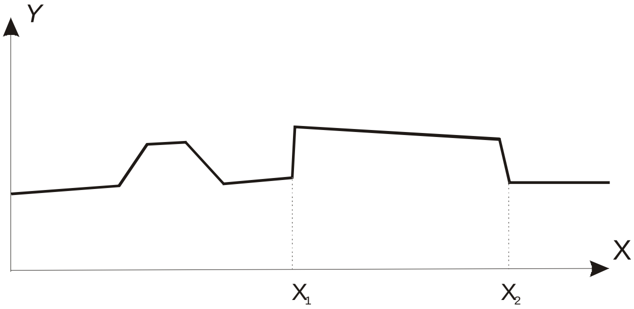

Fig. 4. Segmentation of a curve of value of hue

The most expressed transitions, jumps in a curve of segmentation are determined according to expression:

$$s = \frac{dy}{dx},$$

Where *s* is a factor of increment, dy , dx – increment on an axes *y* and *x*.

The sharp transitions in points x_1 and x_2 in a fig. 4 determine the most expressed values *s* upright components of segments, that will correspond to the most sharp image, on all interval of this section. Under the totals of the image, and also all massif of the images the sharp image is determined most. In a fig. 5 the piece of a massif of the charts of the same piece in range x1, x2 reduced in a fig. 4 is resulted. Thus the greatest value *s* corresponds to value *s4 > (s5, s3, s2, s1),* that corresponds most to sharp image of the given object.

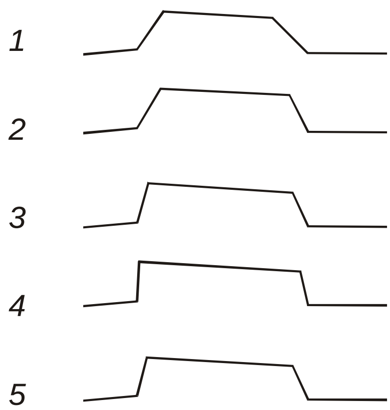

Fig. 5. Piece of a massif of the charts

Conforming to this image d_i, will be used by expression (2) with the purpose of calculus of spacing interval D_i up to suspected object.

Besides apart from spacing interval up to object by more careful examination already of of selected image, probably to determine the sizes of the object (fig. 6). For example on the chart of a fig. 4, reduced for a fig.. 3 it will be possible to note that vertical dimensions of object of the image of flower *h* to be determined by a difference of two coordinates $h = x_2 - x_1$. The sizes of the object *H* can be received outgoing from expressions (1):

$$H = \frac{D_i h}{d_i}$$

More precise size determination of the image needs similar review of a lot of lines, both in vertical direction, and in horizontal direction.

Fig. 6. Localization of object

The obtained data about spacing interval up to object D_i and also about the sizes of object in aggregate with other data, for example running speeds v can be applied to the solution of definite problems for example for a problem of an automatic avoidance of distresses in road and transport incidents. In distresses at critical values D and v the system can execute emergency braking at the conforming technical support, or previously to prevent the driver of probable dangers.

Literature

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