Problem of cartographic display picture visualisation with the help of nonlinear scale function

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The up-to-date scientific and technical development connected with getting and processing a large body of information has caused the problem of faithful perception of such large bodies of information by a human to make decisions. Electronic maps and plans for screen representation should be developed with smooth change of a scale in one or several directions simultaneously.

The up-to-date scientific and technical development connected with getting and processing a large body of information has caused the problem of faithful perception of such large bodies of information by a human to make decisions. In the field of sciences about the Earth and the surrounding space this problem has been traditionally solved by cartographic representation of various information spatially related to a certain projection system and symbols. The demand in routine representation of changeable data and the advent of new computer technologies designed to make maps has brought to life new types of cartographic products which are different from traditional maps and atlases. Use of computer technologies in cartography is a new means of simulation and representation of an area picture, representation of cartographic information jointly with special data.

Maps in modern GIS are a source of information for people, however, excess of information on electronic maps makes it difficult its perception and recognition. It is caused by the fact that the problem of automatic generalisation and selection of data is not solved. Normally, when the map representation scale is reduced, the objects are reduced in size or disappear because the monitor resolution does not make it possible to represent them. Some GIS allow to show additional information when the picture scale is increased, and to remove it when the picture scale is reduced. However, the problem of showing an optimum body of information represented on the display at a time taking into account its perceptibility by a human has not been solved completely.

Both cartographic and traditional computer technologies have the following common principles of making maps and maps' peculiarities related to their human perception:
visual demonstration, quick overview and perception of the most important and significant elements of a map;
visibility, ability to cover large spaces and single out major elements taking into consideration their generalisation and interrelationship; information content, ability of a map to include various data about objects and phenomena.

The combination of these contradictory requirements in tradition technologies has been achieved by a thorough selection of scales and projections, by using inset maps and a series of thematic maps, by thorough selection of the scale of the main map and inset maps, or detailed maps of certain areas, or maps which give an idea of the position of the main map on a larger territory. When computer technologies are used, differently-scaled inset maps are realised in the form of a multi-window interface, i.e. sections of differently-scaled maps or different sections in a single scale in different partially overlapping windows are represented on the same display. The example arrangements of multi- window cartographic pictures are given in Figure 1.

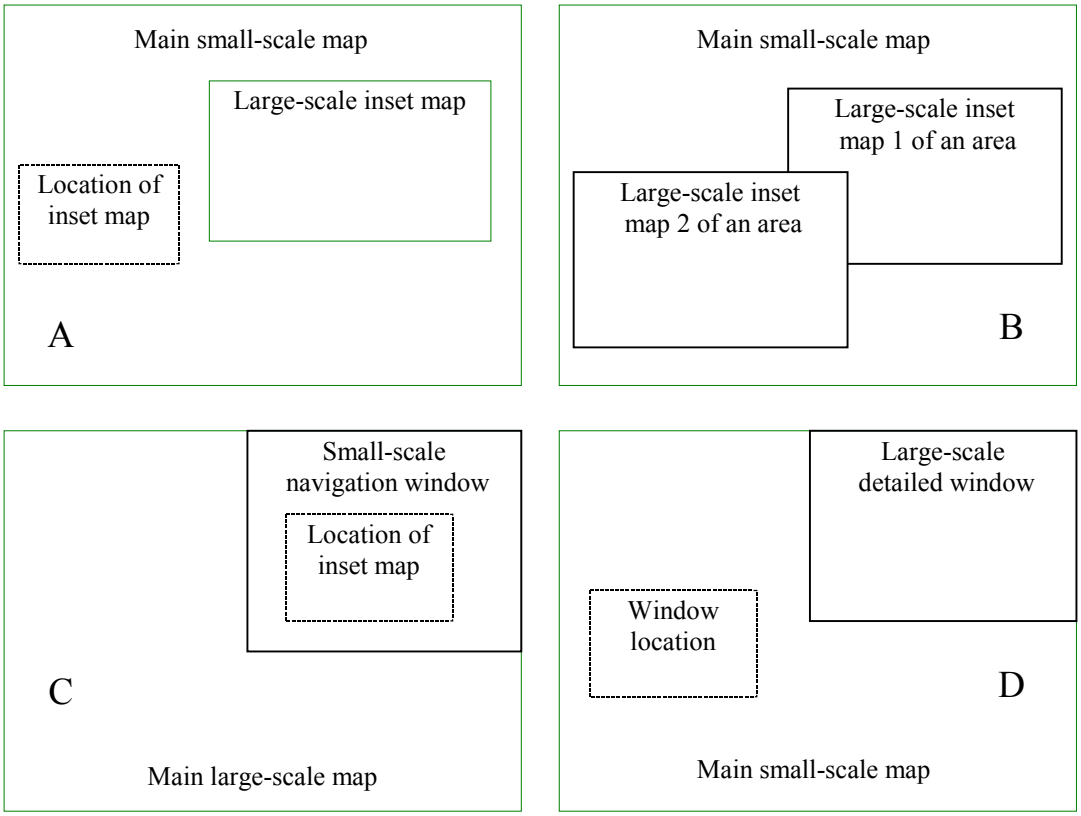

Figure 1. : Example arrangements of multi- window cartographic pictures.
A) Partial increase of a picture in an additional window moved and disengaged at random.
B) Representation of two increased fragments in partially overlapping additional windows moved and disengaged at random.
C) Representation of the main map location in a fixed small-scale navigation window.
D) Representation of a main map increased fragment in a fixed large-scale detailed window.

Cartographic computer technologies make it possible to create maps with an increased informational capacity in comparison with traditional maps. Psycho- physiological abilities of visual perception (size, colour, a number of objects) of a cartographic picture should be taken into consideration while maps are being made because the total body of information contained on a map might not be visually perceived by a human. This raises the question of the selection of maximum permissible body of information to be located per area unit of a cartographic picture on the display.

Computer technologies allow to produce a continuous picture of large areas (in various directions) on the screens of coloured graphic display and to change the scale of this picture and the parameters of the mathematical background, i.e. the picture projection can be easily changed. To make maps with variable scale, it is necessary to meet the following contradictory requirements:

- The objects represented on a map should be perceived as if they were real from a given point of view;
- Geometrical forms of the objects should be represented visually with the help of similar figures;
- A variable scale of a picture distorts the geometrical forms of the objects.

When perspective city and town maps and plans are made according to the traditional practice, the represented area is divided to several sections to design variously-scaled sections (1). Step-by-step change over from a large scale to a small one is made linearly or schematically. In the course of using the traditional practice this kind of work is very labour-intensive and complicated in execution.

When the above features are being used, electronic maps and plans for screen representation should be developed with smooth change of a scale in one or several directions simultaneously. In doing so, the representation of approximately equal amount of information per area unit in a cartographic picture will be the major criterion.

Thus, fragments of city plans with street representation can be made by using smooth non-linear change of the scale in one direction and by carrying out step-by-step selection of information while changing over from a larger scale to a smaller scale. City suburbs maps can be made by smooth non-linear scale change in two directions and step-by-step selection of information while changing over from a larger scale to a smaller scale. Maps of historical places, city

suburbs' heath resorts can be made by smooth non-linear change of the scale in several directions and by detailed representation of the railway station, bus station, city exits, etc. in a larger scale. Then the area along the route is to be shown in a small scale, while historical places and health resorts are to be shown in a larger scale again. The examples of such cartographic representation are shown in the figures below.

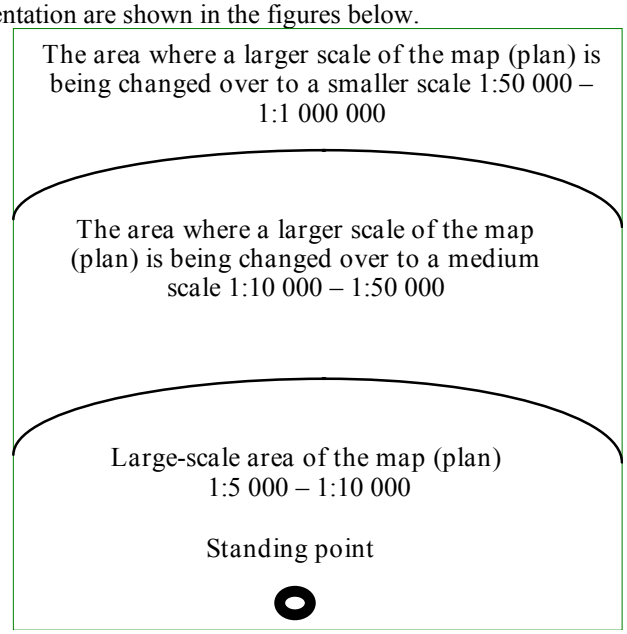

Figure 5. Example cartogram of city plan fragment scales with smooth non-linear change of the scale in one direction.

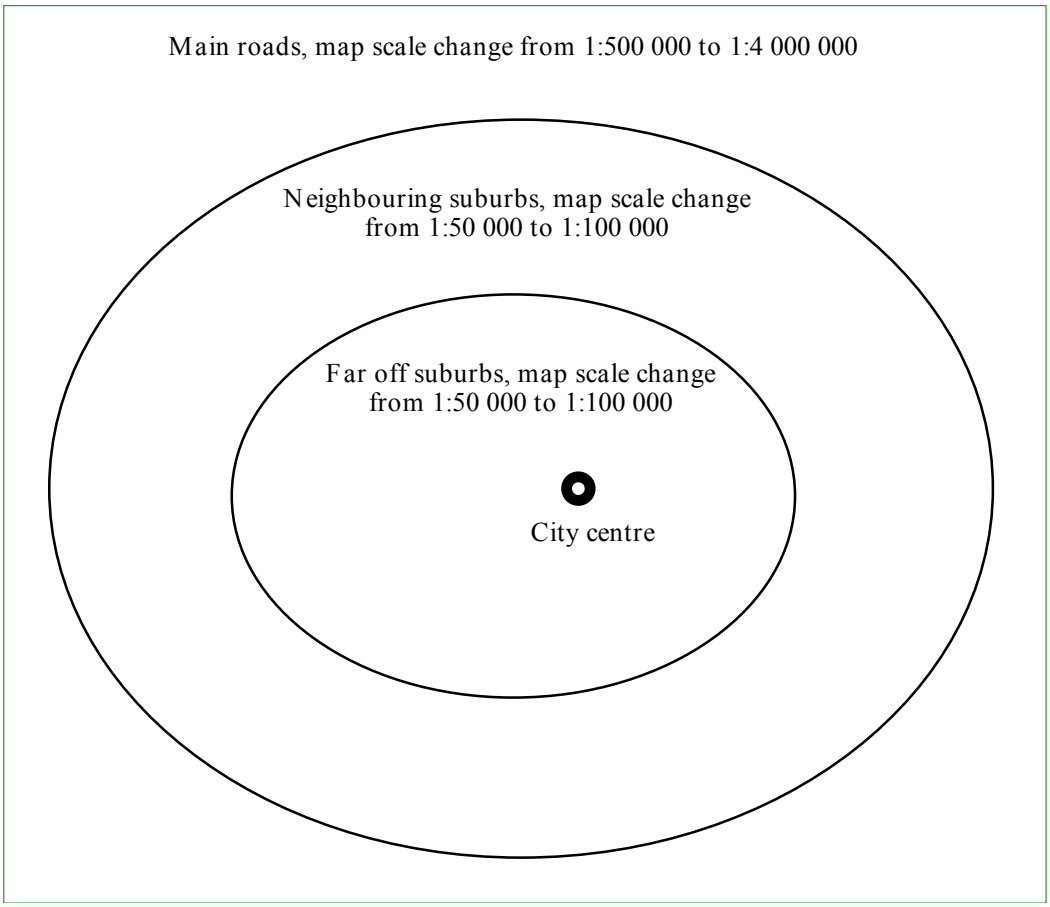

Figure 6. Example cartogram of suburbs map fragment scales with smooth non-linear change of the scale in two direction.

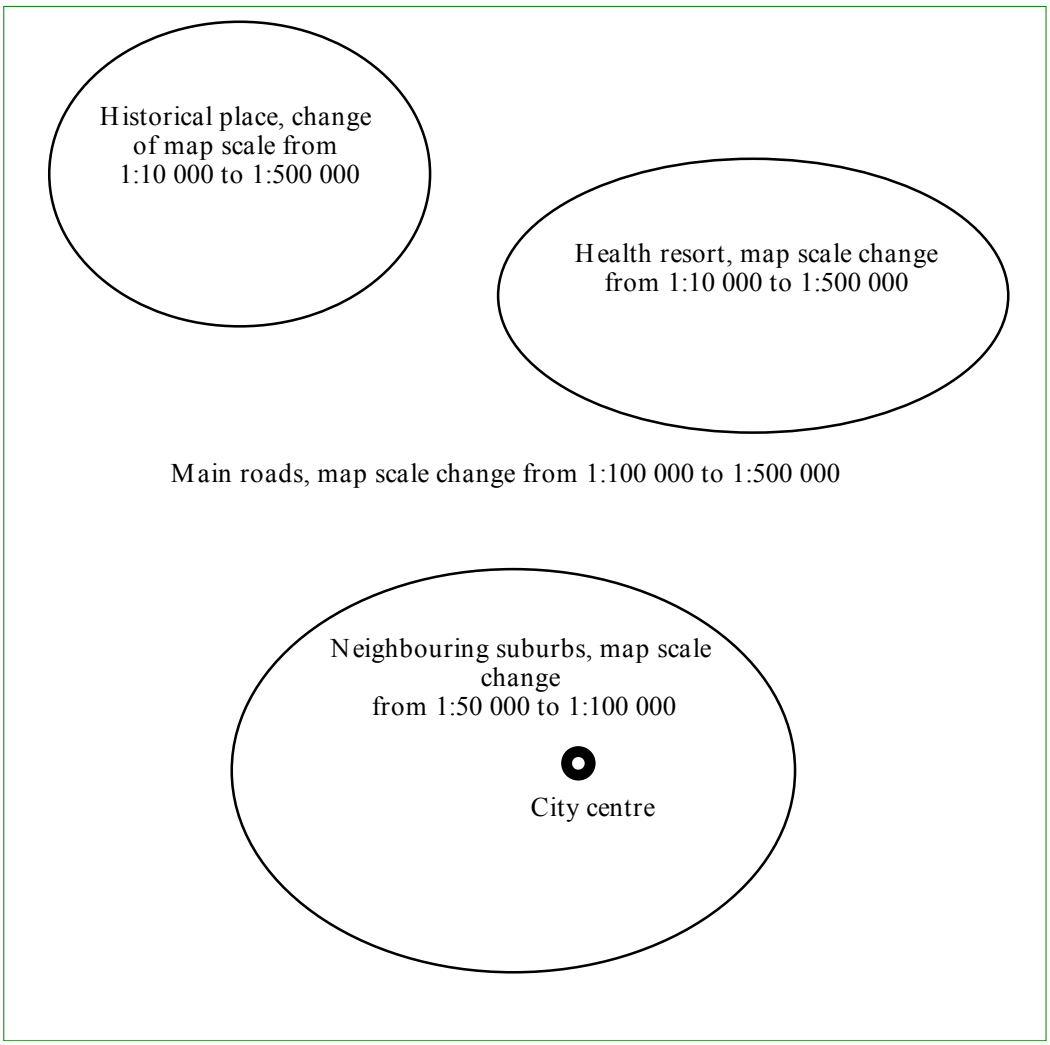

Figure 7. Example cartogram of map scales for historical places, health resorts in a city suburbs with smooth non-linear change of the scale in several direction.

Electronic maps and plans represented on the screen with smooth non-linear change of the scale both in one and several directions should be provided with the necessary software to control the increase/reduction value of the scale in some individual places to get more detailed information of some particular objects and keep the remaining part of the cartographic picture in view.

Reference

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