Poster

A NEW MAP OF THE SKY

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Abstract. The concept of the new sky map of the Astronomical Society "Rudjer Bošković" is presented.

1. NECESSITY FOR THE NEW MAP OF THE SKY

The Astronomical Society "Rudjer Bošković" (ASRB) has published until now four sky charts. One in 1957, one in 1968, one in 1971, and one in 1991.

The first two charts are too old for present-day work.

The third one was designed for the epoch 1950.0 and for use by the medium level amateurs. Stars were drawn on the chart up to the fifth magnitude and -30° of southern sky declinations. The projection of the map is polar equidistant and the diameter is approximately 0.6 m. The map also was showing all Messier objects, meteor radiants, and all other usual objects for a sky map. Such design was good enough for amateur observations until nineties.

In the early nineties ASRB published a small rotational sky chart for amateur use. The chart features stars up to fifth magnitude, appropriate color for night observations, diameter of about 0.3 m and plastic envelope. The chart is designed for 45° of northern latitude. Chart is commercial and ment to be used by the beginners, since no serious work even in the amateur astronomy could be done with this chart.

Since none of these sky maps can be used for an serious amateur work now, ASRB required publication of a new map of the sky. The reason for producing the new sky map is also the fact that we are close to the epoch 2000.0 for which the new sky map is designed.

2. SPECIFICATIONS FOR THE NEW SKY MAP

Since the chart design depends on the chart purpose, it was first necessary to define the purpose of the new map. It was decided that the map is to be used mostly for educational purposes for secondary school pupils. The map has to show clearly: the constellations, their boundaries and basic elements of the celestial sphere. The projection of the map was chosen to be a polar equidistant one. The diameter is 0.7 m. The chart is expected to be printed on A0 paper format. It can be used as a poster in a classroom as well as for night observations. The map also should be useful to the medium level amateurs. For these purpose, and in harmony with the

map diameter, stars up to the sixth magnitude are drawn on the map down to -35° of southern declinations. The map also shows all nonstellar objects of interest for amateurs.

3. CONCEPTION OF THE WORKING TASK

Considering extensive use of computers in astronomy and amount of work needed, the new map of the sky was developed on the computer. It was decided to use Auto Desk's integrated development environment AutoCAD release 12. The advantages of this environment, relatively to the others, are great.

First of all, it is the ease of plotting precise large scale drawings. In connection with this fact is also a problem of line thickness on pen plotters. In case of the new map, the following method was used: drawing the objects was done not as vectors in different colors - one color represents different pen thicknesses on pen plotters - but as thick lines and daughnuts. It is assumed that the chart will not be plotted with a pen plotter. Exception to this rule are text drawings, for which different colors for different thicknesses have to be used.

A great advantage, and the most important one, is the ability of using AutoLISP language. The whole new map of the sky is drawn by the AutoLISP routine called "Karta" (*Chart*).

Using these two features of AutoCAD environment was the easiest way for developing and plotting such a complex drawing. It is still an open question whether any other graphical developing environment can stand drawings like the sky chart.

The AutoLISP routine "Karta" is the central entity in the new sky map production. The routine is designed as a set of six functions. Each one draws one part of the chart: coordinate lines, stars, star names, constellation lines, constellation boundaries and the Milky Way. There are also two other functions for preparation and finish of the chart task in AutoCAD environment. The functions are designed so that at the beginning of each one there is a set of constants. Their purpose is an easy control of parameters on the resulting drawing. The routine "Karta" itself has only two variables: radius of the map and the value of farthermost declination to be plotted within a given radius. The flexibility of the mentioned routines is required in order to make experiments with some relations between the objects on the sky map.

4. FUNCTION DESCRIPTION

The function for coordinate lines drawing offers great flexibility in drawing polar equidistant coordinate system. There are possibilities to control many values which are related to the line thickness, declination of the beginning of the declination arcs, density and the beginning of the fine graduation on main coordinate lines, etc. This is achieved by adducing many initial constants.

The problem of presenting star symbols on sky charts is practically an astronomical one. There are no restrictions in programming this part of the chart. It is only necessary to find the appropriate ratio of the star symbols radii so that they represent the stellar brightnesses as fittingly as possible. Star positions, as well as their names, are readable from a separate file.

Star names, and all other marks which have to be printed close by the star symbols, constitute the most serious problem. Since the star chart has approximately 3850 drawn star symbols, it is very hard to write some intelligent algorithm which will allow free space for this characters. The basic idea is to determine the initial position of a star name and other marks, and then to try to select all possible objects at that place. If there are no objects, the place is free. Conversely, another place has to be found.

Constellation lines are easy for drawing. Each constellation can be presented as a graph with nodes placed at star positions. The data structure which can describe this process is the so called *list* - the basic structure of AutoLISP language. Positions of star indices are used for connections and are readable from a separate file.

A similar problem is with constellation boundaries. The situation is the same as for constellation lines except the fact that graph nodes are readable from a file which provides the IAU.

Milky Way drawing is again the same problem as the two previously mentioned, where graph nodes are positions of points on the Milky Way density isophotes.

5. FURTHER IDEAS

Drawing of the sky chart is not a small problem, even if a computer is used. Anyway, the method described offers many interesting possibilities for further development.

First of all there are some interesting ideas conected with drawing of nonstellar objects. Since the AutoCAD can import pictures in GIF, PCX or TIFF formats, perhaps it is interesting to import pictures of some nonstellar objects directly on the chart, so that they can be presented as they really are on the sky.

Since the main AutoLISP routine is composed of smaller routines, each one of them can be turned *on* or *off*. This is interesting because it offers the possibility to print charts for special purposes: learning the constellations, learning star names, finding nonstellar objects, etc.

It is also possible to print transparent grids for precise determination of coordinates, by using the function for coordinate system drawing.

Another interesting possibility is further chart development. When main routine "Karta" is developed, it is much easier to write some other routines, for a sky atlas, perhaps, or for some other special projections of the celestial sphere.

It is also desirable to develop some text documents as an user's guide for the new map of the sky. These documents can even be presented in HTML format for WWW as an appendix to the chart. This document can guide users through the constellations and interesting sky objects.

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