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numeric co-processor to an even number. I have changed in some programmes the rounding procedure to a third possibility, namely always to a greater value (by a function RoundUp). The second problem concerns formatting. With co-processor, all unformatted real numbers are output as extended, with e.g. four digits in exponent. Some formatting procedures at the beginning of `str_num` unit overcome different behaviour of different hardware.

The programmes are English-written, with few exceptions. Why is that so, when most of the users are speaking Czech? The main reason is, that the author hates disabled Czech without diacritics, and that Czech diacritics has not just one possibility how to be implemented in the computers. The problem of two main MS-DOS-based "code pages" can be solved by the programme `CS_Conv`. But the English programmes are easier to read, when names of variables, subroutines and comments are English as well as the programming language. And each potential user of these programmes surely reads English, with some effort at least.

If you make some programme better, and you suppose, that your adaptation may suit another people as well, please give them whole this package including your addition. I welcome you sending the modified programme me as well. I will gladly discard the original work and replace it by the same-named version by you in our set.

As follows from the License [2], everybody can modify the programmes and use their parts in her/his own programmes. If such programmes are spread further, they are obliged to remain free software subject to the same Public License.

If the change of a programme concerns only

- the list of directories where the data files are sought for, or
- the five default constants concerning the observing site (these are at the beginning of the `solar_ut` unit),

the programme can keep its name and no notice on the change is needed. The same holds in case, when just explanations are supplemented (it may be needed in some cases, to make the use of the programme understandable to another people than to author himself).

4 Handling the programmes

Some programmes explain how to use them, whenever they are run without parameters (this applies for those ones, which always need some parameters). Another ones offer instructions to users, if at least one of parameters is `?` (or `/?` or `-?`). Programs with long explanation should give a possibility to write it into a file instead to a screen. Mostly the standard redirecting of the output can be used, as `fGCVS >> fGCVS.hlp`. Some programmes, which have to react on each key during their work, make redirecting impossible, however (the `crt` tool of Borland Turbo Pascal language is guilty). These programmes create a file `*.hlp`, when asked to do that by `/h` (or `-h`) parameter. For example, `graph_d -h`.

All of the programmes are controlled by the parameters on the command line. Saying *parameter*, we understand a "word", single parameters are (as usual with

thick sheets (consult the manual) — they should just have smooth surface to accept the paint.

8.3 Stereoscopic maps

Parameters `s` and `sc` or `sm` enable generating pairs of maps, which can produce an illusion of a 3-dimensional scene: just one map, showing the various objects in various distances. However, if you are not experienced in viewing stereo images, you may find it difficult to reach such view at all, not to speak about viewing the 3-D image comfortably.

The impression of the depth is attained in such a way, that the stars in maps for the left and right eye are shifted in various extent with respect to each other, according to their distance from the Earth. The lines connecting the stars with the appropriate eyes are to be more convergent for the near stars. This convergence is called parallax. 'Astronomical parallax' concerns the case, that the 'eyes' are one 'astronomic unit' apart, or some 150 Gm. Astronomical parallaxes of fixed stars are smaller than one arcsecond. For the stereomap to work, the plotted parallaxes are to reach some tenths of a degree for your true eyes.

A comfortable view can be attained in such a case, that the convergence of the eyes corresponds to their focusation (accomodation). A perfect match can hold just for the only apparent distance, preferably for distant stars with almost zero astronomical parallaxes. Stars with a larger parallax seem to be closer, but the eye accomodation is unchanged, as in reality all stars are plotted in the same plane. This is the reason why no stereogramme reaches the quality of a hologramme, and why viewing means always some eyestrain.

The match of convergence and accomodation for distant stars can be reached by using suitable glasses. For example, if the distant stars are plotted in the same distance from each other as the mutual distance of your eye pupils is (say, 65 mm) and your face is some half meter from the screen, you need to strengthen the dioptric power of your eyesight by two diopters. You should use glasses with convex lenses of this power, or with the focal length of fifty centimeters. Such glasses are common, quite a lot of elderly people use them for reading. If you would have just glasses having four diopters, you should watch the maps from a distance of a quarter meter. Majority of stars would appear in a large distance and just the closest stars would emerge as near to you.

If you take glasses having two diopters (or, as myopists, you put off your glasses of -2 D) and you want to watch the map from a distance less then 50 cm, you have to use another base shift of star pairs. For a viewing distance of 25 cm the shift should be just half of your eye baseline (just some 32.5 mm), otherwise the view would be painful. In such a situation you have no impression of a distant universe, but you see most stars as if being in a plane half a meter from you, and just some dots are perceived nearer. These are more difficult to see, due to the non-matching convergence and focusation. You can see them better, if you get close, but then the view of the more distant stars becomes less pleasant.

directory programme	
vlnka2	replaces spaces by \ after specified one-letter prepositions or by ~ (default) (a slight modification of Vlnka.pas, offered by CSTUG[17])
Astro	*Astronomical programmes*
Dif2Rat	Difference of Faintnesses / 1 mag → Ratio of Brightnesses
Ecl2equ	Ecliptical length and width → RA and declination
Equ2ecl	RA and declination → l and b (ecliptical longitude and latitude)
Equ2gal	RA and declination → galactic longitude and latitude
F_GCVS	Information on a star from the General Catalog of Variable Stars (GCVS)
Faint	Faintesses of stars from a matrix of their comparisons, rough work
Fai2Bri	Faintness (and distance) → brightness and energy domain
Fourierm	Frequency diagram from data of a special format, in Czech, by Leos Ondra
Grid	Meridians and parallels for a rotational ellipsoid, like Jupiter
Hel_Cor	Heliocentric correction (a quantity used for variable stars)
Lum	Luminance expressed both standardly and in a queer astronomical way
Map_mGSC	Plots a star chart (from the Guide Star Catalog as packed in MegaStar ver. 3)
Map_wire	Length of deformed main circles in "true-polar-distance" maps
Moon	Lunar ephemeris (daily — main phases only — eclipses only)
Mul_fai	Faintness of a group of stars from faintnesses of its members
Nights	Times and azimuth of Sun passing a given angular height
Noci	Times and azimuth of Sun passing a given angular height, a Czech version
Padi	Angular distance of two points (or stars in the Bright Star Catalogue)
Planet	Positions of Planets (in the old sense of word, including Sun and Moon)
Posi	Positions of a body from elements of its heliocentric trajectory
Pre_d_bj	Example of precession from B1950 to J2000, for file Planets.dbf
Pre_g_bj	Example of precession from B1950 to J2000, for file GCVSred.dbf
Preces	Equatorial coord. of a star: original frame (B1950) → new frame (J2000)
Rat2dif	Ratio of Brightnesses → Difference of Faintnesses / 1 mag
Sol_Temp	Radiative balance – temperatures on insolated bodies
Star_pos	Angular height etc. of a point (or star in the Bright Star Catalogue)
Star_tim	Time of reaching an angular height (for fixed stars, planets, Sun, Moon)
Sun	Julian date, sidereal time, position of the Sun
Sun_ph	Equinoxes and solstices
Sundial	Planar sundials and Insolation of collectors and windows
Time2JD	Writes Julian dates (or MJDs) into a dBase file
Tr_bin	Trajectory of a visual binary star
Var_Dif	Writes average departures, their standard deviations and changes into a list of comparison stars and then writes the faintesses into a list of comparisons
\Map_BSC	*Program Map_BSC and the related stuff for bright star maps*
Map_BSC	Plotting Star Maps from B5_cd.dbf, obj.dbf and planets.dbf
Scale	Times versus dates, a scale for zenith star maps (Czech, LaTeX)
Scale_v	Times versus dates, a scale for zenith star maps (*.eps, vertical)

directory programme	
\CCD	*Programs for Santa Barbara Sci.Instruments Group CCD cameras: five working ones for the ST4 camera (but not much checked) and a draft viewer for the ST7 camera and FITS images.*
FITSstVw	Displays a CCD image from ST7 SBIG camera or a FITS 16-bit image
pCCD1	Draft program showing a CCD image by ST4 and a MegaStar GSC map
S4	Displays an image from Santa Barbara ST4 CCD camera
S4df	Subtracts dark frame from an image by ST4 CCD camera
S4fa	SBIG-like "Flat-field" transformation of an image by ST4 CCD camera
S4fs	Natural "Flat-field" transformation of an image by ST4 CCD camera
S4m	Measures a stellar image from Santa Barbara ST4 CCD camera
\Min	*General program for predicting periodic phenomena, but with just one-purpose data; by Rudolf Novák.*
Min	Times of extrema of variable stars (of eclipses in eclipsing binaries)
Fun	*Programs for J. Hollan's children, demonstration and educational trifles*
Doppl2vs	Conversion of acoustic interval into vehicle velocity (with sound demonstration)
Doppl2v	Conversion of acoustic interval into vehicle velocity
Doppl	Sound of a body on a circular orbit: hearing the Doppler effect
Morse	Beeps letters in the alphabet of Morse
P	Screen writing with script letters (scaled by + or − key); Czech code
Piano	Plays tones given by keys; <Shift> makes them a halftone higher, <Ctrl> lower
Play	Plays a melody from a simple text file (see Melodie.txt)
S	Screen writing with SansSerif letters (scaled by + or − key); Czech code
Tada	Adding and subtracting excersizes, conversating in Czech
TadaN	Multiplying and dividing excersizes, conversating in Czech
Screen	*Setting video modes, various tests and operations with graphic screens. The most useful programs are:*
Vmod	Setting video modes of VGA cards (standard, VESA 6a, card-specific ones). A crazy screen can be often cured by: VMod 3
VmodV	Setting video modes of VESA-obeying SVGA cards
Tisk	*Czech and graphic print on an old large dot printer CS 212-25, controling Epson printers (in Czech). The only program for standard printers is:*
Setlpt	Controls printers using Epson language, in Czech
Units	*Units for programs used by Jan Hollan*
Angles_O	Angular and matrix operations, Opening text files
Binaries	Information on a binary star from Binaries.dbf

8.2 Assembling a pair of planispheres

If you happen to live near the latitude 49.2°, you can use the prepared maps in the `astro\map_bsc\maps` directory. Otherwise, you should run the batch `mb_ns_ch` with appropriate latitude parameter. Take the four resulting sheets and view them. To save you experimenting with proper cuts, folds and gluing, I recommend you the following procedure.

First, your printer may distort the picture, what is bad especially in the case of the border circle. To correct or check it, take a compasses and make a circle centered at the pole; the circle should be just slightly smaller than the printed one.

The hole you have made in the pole will then help you to align the two maps back to back properly. Properly, it means with the stars to opposite directions. Stack the maps on the window and match the poles; the rims of paper should remain parallel. Press the left half of stacked sheets firmly against the window, bend the right half ot the top sheet left and put some glue sparsely on the the bottom sheet, just a band some one centimeter wide along the border circle. Press the top sheet quickly there, so that the bottom sheet gets no more wet than the top one. When it holds after some five or ten seconds, repeat the procedure with the other half of the sheets. Then you may cut it along the border circle.

The two masks should be handled differently. The southern one (stereographic, with all curves being circular arcs) should be cut along the straight lines, and then along the horizon (or very slightly outwards). The "clock face" will remain on the resulting part.

The northern mask should be not cut but folded around these straight lines. Cutting the northern mask is a bit more complicated. Cut it along the other straight lines, prolong cutting along the border circle, and continue along the curve of an angular height of -30 degrees. Then the inside part of the mask is to be cut away: along the horizon, of course, so that the "clock face" will be discarded; you may wish to cut a bit more inside, to leave azimuth marks intact.

The two masks are then to be glued together in an obvious way: put the southern one inside the folded northern one, center it properly (to compensate for possible printer distortions), and glue the folded part of the northern mask onto the southern one.

Then you can insert the two-sided map into the pocket formed by the masks (northern map should be under the northern mask), align the month (or its proper part) on the map with the time (local, not "summertime") on the mask, and you will see which stars are over horizon.

If you prefer to join the pair of maps with their masks permanently, print the four sheets once more, and cut the northern mask along four tangents * of the marginal dashed circle. Cut it in the cusps till that circle, and fold the halved cusps over the inserted pair of maps. Gluing the halves of cusps together will make the charts permanently masked.

Of course, hard paper will do a better job than an ordinary one; laser printers are adapted in seconds to print without bending the paper, and can tolerate quite

real words) separated by spaces. Controlling programmes by parameters is comfortable thanks to the fact, that the command can be repeated many times with just small changes of parameters (directly from MS-DOS you can do it easily, when the `DOSKey /insert` runs). Even greater advantage is a possibility to make batch files (i.e. `*.bat`), where some parameters are defined already (e.g., your geographical coordinates).

The above-mentioned programme `graph_d` is one of few exceptions. If you use it for polynomial (usually linear) regression of data, or if you try to find their axis of symmetry, then the programme asks you some questions also in the course of the work. This conversation is implemented in a rather simple way (it is an old programme already, what appears also through an unusual shape of its command-line parameters), but it suffices its task.

Most programmes in our set, which produce a graphic output on the screen, can simultaneously create a corresponding file with a picture in LaTeXor PostScript language (file `*.eps`). Using them, you can produce prints with unlimited resolution, and modify them before the print by any text editor. This is a notable advantage over those commercial programmes which offer a mere possibility to copy a screen on the paper. As far as PostScript [14] is concerned, it is language of all advanced printers and photo-setting machines. If you have none, install GhostScript (http://www.cs.wisc.edu/~ghost) into your computer. Its supplement PSView can be then used for comfortable viewing of PostScript outputs on the screen.

As the graphic screen may pose problems in some cases (e.g., on Linux text console), the graphic programmes may be converted to text versions, which produce just the PostScript output (there are conversion batch files available).

5 Remarks on selected programmes

I have mentioned the programme `Graph_d` already. It produces graphs and histograms, preferably from files of `*.dbf` type. It can handle also text files, which have some columns of numbers inside of them. Its another special feature is, that it can stack the data according to the given period, or even find their symmetry axis (this is a common task in astronomy).

The same directory `Util` contains a couple of another programmes I often use. One of them is a programme `CutBE`, which can copy a part of any (large) file, and by running several times, divide the file to several parts (see batch file `cut10`). The copied parts of reasonable size can be then edited by common editing programmes and by a MS-DOS command `copy` glued together to a single file again (see `copy10.bat`). The `CutTrBla` programme cuts away obsolete spaces at ends of lines of a text file (most editing programmes make it as well, but just for small files).

From the `Astro` directory I use many programmes quite often. The most complicated one is contained in a separate directory `Map_BSC` and described in the last section of this booklet. Another mapping programme is `Map_mGSC`. It uses the famous *Guide Stars Catalogue*, in the version of the MegaStar atlas [12]. To be able to

[15] ScreenThief, a program by Villa Software, available, e.g., at http://www.simtel.net/simtel.net/msdos/graphics-pre.html as st201f.zip. A local copy is ftp://astro.sci.muni.cz/hollan/programmes/st201f.zip

[16] See pages of TEX Users Group, http://www.tug.org

[17] Československé sdružení uživatelů TEXu, see http://www.cstug.cz

[18] Examples of screens captured from star-mapping programmes `map_bsc` and `map_mgsc` can be seen at http://astro.sci.muni.cz/pub/hollan/programmes/images.

[19] Twocolor glasses for viweing anaglyphs (as well asl polarization and diffraction ones) sells, e.g., http://www.rainbowsymphony.com

1 Introduction

The set of programmes has been made at the *Nicholas Copernicus Observatory and Planetarium in Brno* (http://www.sci.muni.cz/obsbrno). It contains mostly work of members of the *Amatérská prohlídka oblohy* (*Amateur Sky Survey* [3]), whose professional member I am. The programmes solve a lot of various tasks I have encountered, astronomical and another ones.

All programmes and their parts are *free software*, and to ensure the freedom further on, their use is regulated by the GNU General Public License as published by the Free Software Foundation, either version 2 of the License, or (at your option) any later version. If you do not have the text of the license (it should accompany the programmes as `gpl.txt`), you will find it at http://www.gnu.org/copyleft/gpl.html. The same directory (http://www.gnu.org/copyleft/) gives also the reasons, why is such specification needed and what *free software* in general is. GNU license demands, e.g., that anyone, who gets some of the programmes in an executable form, would obtain its original text or an information, where it is available.

The programmes can be best used by those people, who have access to the Borland Turbo Pascal compiler, or who will download a very good Free Pascal Compiler [4]. The last one works on many platforms (under Linux as well). Source texts of all programmes are available as a packed file `pas_jh.zip` at

http://astro.sci.muni.cz/pub/hollan/programmes .

The same address hosts also translated executable files for a PC-XT with numeric coprocessor (as a package `exe87_jh`), for a PC without it (`exe_jh`) and for Linux PC's. The disadvantage of executable files is they cannot be adapted to your environment, which can differ in directory structure, time zone, etc.

Some programmes need astronomical data, and these are available as further packages (or archives, `*.zip` files). The packages are packed by programme `pkzip` (or by programme `zip`, on UNIX platforms). They can be "unzipped" by e.g. `pkunzip /d pas_jh.zip` or by `unzip pas_jh.zip`.

2 Using computers with MS-DOS

To make a computer serve you well, you need to configure it properly. Start with the file `AutoExec.bat` in the root directory of MS-DOS[1]. I recommend you very much to define the beginning of "environmental variable" `Path` (list of directories, where executable files are sought) as

`Path=C:\bat;C:\DOS;C:\s\exetpu;`

— the very beginning is the directory with batch files (programmes in the operating system language), which you use to start programmes contained in many different directories. There is no need to include these many directories into the `Path` variable.

[1] This simple operating system (or its analogues ∗-DOS) used to be the only one for "personal computers". It can be run on these computers (at least simulated) from more sophisticated systems as well, and so most of the programmes written for this old system can be used further on.