Astrolabium

Instructions for Use

This program is designed to print out a *tympanum and rete* of the sky on A4 paper. These are the essential components of an astrolabium. It is possible to limit the number of stars (around 1200) and constellations to those of the zodiac. Any latitude is possible, northern or southern. It shows the planets, the sun and the moon. In addition to drawing the map, Astrolabium supplies a huge amount of useful information for stargazers. At start-up the program shows a console that provides the gateway to three separate pages. The top, left-hand section is common to all three. Click on **Run** and the program will do so using the default data it contains. There are a number of variables that can be altered: latitude (in decimal form) which is positive for the northern hemisphere and negative for the southern; longitude (in decimal form) which is negative east of Greenwich and positive in the opposite direction; the radius; the Standard Time Zone (-1 for Central Europe). The **Update** function, followed by **Run**, updates the image every 60 seconds, or whichever interval is set. Under **Options** it is possible to select a traditional stereographic projection from the South Pole for the Northern Hemisphere and from the North Pole for the Southern Hemisphere or a stereographic projection from the Nadir. **This last option cannot be used to produce an astrolabium but is an interesting variation.** Click on **Tools** to access a number of options: **Moon Ephemeris** gives the moon's ephemera; **Orbital elements** opens a large window containing the ephemera of the planets, the sun and the moon; **Moon's phases** contains the dates of the lunar phases; **Galileo's satellites** contains the co-ordinates of the Medici "planets" and a chart of these as seen from Earth; **Cassini's satellites** contains the co-ordinates of the eight main satellites of Saturn and a chart of these as seen from Earth; and the last command shows the dates of the equinoxes and the solstices.
The question mark provides information about the program itself.
Page 1 contains a number of options for adjusting the chart. The following features can be altered if desired: the Tropic of Cancer, the Tropic of Capricorn, the equator, the ecliptic, the azimuth lines (every 10 degrees), the almucantarat (every 10 degrees) and twilight (every 6 degrees – -6, -12, -18). Then the stars, constellations, the sun, the moon and the planets can be enlarged or can appear in their correct proportions. The size of the planets can be modified under **Planets**. By choosing Apparent Sizes we can see the sizes of the planets with the same ratio as they appear thought a telescope. With an opportune small value of the radius the disc of the sun and that of the moon will be entirely shown on the screen letting us to estimate their apparent sizes by graphics.
Then there is the sun's azimuth and its apparent height above the horizon. Then Real Sidereal Time in Greenwich (corrected for aberration and nutation), Julian Date, the date, Local Standard Time, Local Sidereal Time (which determines the position of the sky from a given location), real time (as given by a sundial) and finally the equation of time.
The second page contains other data: the hour angle of the sunset; that of the sunset with respect to midnight; the time the moon rises; the corresponding azimuth and the time the moon sets with the corresponding azimuth. Then there is sunrise, the sun's azimuth, sunset and the corresponding azimuth. All the azimuths are measured from South and have a value between 0 and ±180. Then there is the option to enter the mean time analemma for local time based on midday. The virtual analemma has an interesting feature that cannot be reproduced on sundials. A circle of a diameter equal to the sun's moves along the analemma. It completes the circuit, which is subdivided into monthly sections, in the course of one calendar year. At 12 o'clock the sun sits precisely on its image. Italic and Babylonian hours are shown in 24 hour format. Temporal hours are in 12-hour format. Click on the relevant commands at start-up to see these charted on the astrolabium. Further down there is a text box which records Sidereal Mean Time at Greenwich. Then there is the date for Easter Sunday, the date according to the Muslim calendar and the date of the Jewish festival of Pesach.
At the bottom of the page there are two further options: one to enter the names of some of the stars and the other allows a choice of background colours for the sky.
The third page is where the simulations take place. The precession shown on the graph takes account of shifts in the vernal point (a red dot marks the point, as does the Greek letter γ), and of movements of the stars themselves. It is possible to enter a **date** at will, TD, Local Sidereal Time and the Julian Date of the ephemiridis. Click on South Pole to highlight it with a red dot. **Quick Run** moves the date forward by the unit of time selected. The **Quick Run** function generates an updated image of the sky. It can also be activated through the satellite options. Click on **QR**.
Astrolabium is based on *Astronomical Algorithms,* a book by Jean Meeus, which makes use of a reduced version of P. Bretagnon and G. Francou's theory VSOP87. It is essential to use TD, Dynamic Time. The program calculates Dynamic time and Δt = UT - TD which appears under **Data and orbital elements** (top right). If therefore universal time for the event to be simulated is known, TD must be entered, i.e.

Universal time adjusted for Δt. For example, if the position of the planets is calculated at 0 UT on the 12th October 1974 where Δt = 46", in the textbox for TD enter 000046. If Δt is negative, the date must be set back one. Consider 0 UT on the 12th October 1890 where Δt = -6: the new date will be the 11th October 1890 at 235954 DT. Δt however tends to be greater than zero and tends to increase further with time. Between 1900 and 1997, values for Δt are very accurate. For other dates, the figures supplied by the algorithm are reliable but not as precise. Also, the program receives a time directly from the computer which Astrolabium considers to be dynamic time. Assuming that this time is correct it is Local Mean Time and therefore Universal Time (regardless of the one or more hours of time difference, depending on the time zone). If the result is to be exact, the computer's time needs to be adjusted for Δt. But I think this is a minor issue since the difference between the two times is a matter of seconds and it is pointless to attempt to be accurate to the second. This degree of accuracy can only be achieved through the simulation. The time introduced during the simulation is meant as Time Dynamical. If it is used for calculating other data, like Sideral Time, Azimuth, Sunsets, Sunrises etcetera is indented as UT.

Let me propose an example in order to clarify this concept : let us suppose that we want to know the position of the planets on the 25th may 2008. The simulation is carried out after introducing the date and the hour. The time is interpreted as Time Dynamical. When we click on Simulation the STZ textbox shows automatically 0 (zero) that is meant the longitude of the meridian of Greenwich. The Check box of the *Simulation* must remain clicked. The consequent data and the position of the sky with the planets are referred to the time of the Simulation. I we wish to know an astronomical phenomena according to the UT we must convert it in DT. For instance let's suppose that we need to know the position of the satellites of Jupiter on the same data but at UT = 0 we introduce the data and the time 00 00 00. On the Orbital elements form we can read TD = 76.28". We must perform the simulation introducing 00 01 16 in the text box of the time. If we want to know the Solar Noon of a locality situated at latitude 45° and longitude –10° (STZ = -1) we introduce the latitude, thereafter we click on simulation and then we introduce the longitude –10° (STZ = -1). Now we can read the Solar Noon that is **12 16 57**. Now we use this value to complete the simulation. We write it on the text box reserved to the time, we make sure that the SZT is still –1 then we run the programme. We'll see the sun positioned exactly on the meridian line to confirm that the procedure is correct. It is also possible to compare the disc of the sun with the disc of the moon. The program also works perfectly in the Southern Hemisphere. To obtain a projection of the sky as seen from the Southern Hemisphere, both latitude and radius measurements need to be made negative. If one or other carries a + sign or if projection from the nadir is used, the results will be incorrect. The part of the sky that is below the horizon is obviously not visible to the eye, but here it is shown with a black background so that the stars can nevertheless be located. The program does not recognise Daylight Saving Time during a simulation so then the DST command becomes ineffectual.

The program already contains default data for latitude, longitude, radius, STZ and the latitude and date of simulation. If any of these are missing it gives rise to a **runtime error**. It is therefore recommended that you enter this and other information as desired if it is missing.

Error messages: **runtime error 6** is caused by missing information in the boxes labelled **input**.

Runtime error 13 is caused when the figure entered is incompatible, for example if a numeric character is replaced by a letter of the alphabet or other. The same error arises if the international settings are incompatible with the program, for example when dates are written using the slash as a divider instead of the decimal point.

Conditions of use

Astrolabium.exe is the *demo* version of a freeware programme. Use of the product is not permitted without the authors' permission. The authors own the intellectual property rights to the programme. They take no responsibility for any malfunctions or any consequences arising from improper use of the same.