AURORA

A Computer program to analyse Auroral- and FAI-scattering

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This article is a translation of the original paper published in DUBUS 1/88, pages 18-21. The author appologizes for not supplying the English text until now. No disregard for subscribers outside DI was intended. Translations simply require more time, which is unfortunately not always available. For the same reason an international version of the program and the manual will not be announced in the near future. In fact the author did not expect such an international response to his public domain software. Translations will be made step by step and new program developments will consider the needs of international users from the beginning.

The computer program AURORA is developed for use on an Atari ST system. At least 1 Megabyte RAM is required, a double sided diskdrive and a monochrome monitor must be supplied for operation. AURORA is public domain and free for noncomercial use.

AURORA analyses VHF-scattering by field aligned irregularities in the E-region level (radio-aurora and FAI). The program has three areas of application:

- realtime analysis of Aurora- or FAI-bandopenings
- studies of back-dated events
- preparation of radio schedules (in particular FAI-tests)

In all cases the location of a radio terminal is assumed as reference (e.g. location of your equipment). The most simple application needs as further input data the geographical position of one or more Aurora- or FAI-scatterers, which are set by mouse clicking areas on the screen map. Taken account of the optimum condition for scattering (see e.g. [1]) AURORA calculates all possible locations of QSO-partners. As results curved lines on the Earth's surface are obtained, which are called contours. Using AURORA instead of the graphical method of determing contour-lines (see e.g. [2]) has several advantages. The usage is easier and the accuracy is increased. The graphical method requires manual alignment of contours (usually in the form of printed slides) on a map. The alignment must take the local declination of the Earth's magnetic field in E-region level into account, thus, a proper set of contour-lines must be available which are consistent with the local inclination. Due to practical limitations, the graphical method often leads to approximations of limited accuracy. AURORA makes use of a build-in subroutine which calculates the direction of the Earth's magnetic field for arbitrary locations on the Earth's surface or in the atmosphere.

Computing the locations of QSO-partners by defining the positions of the scatterers is, in fact, not practical. During a bandopening we do not really know where the particular scatter-volume is - we just have knowledge about the locations of the radio stations which can be monitored. A more sophisticated application of AURORA is to find out where the radio-aurora or FAI is situated by using this kind of information.

Two stations are assumed to communicate via auroral-scatter in picture 1 (please refer to the original paper in DUBUS 1/88). The location of reference is FM42f (open circle) where a station from GP21e (arrow) is monitored. The shaded areas show all possible positions of auroral scatterers (a height of 110km is assumed in this calculation) which could establish a radio link between both terminals. The result is ambiguous because the scatter-line extends from Scotland to Finland. The antenna heading gives first information about that part of the scatter-line which really contributes to the actual QSO. However, AURORA works in a diffrent way. Picture 2 assumes a second radio station in ZO71e

which also contactetthe point to reference in FM42f. A southward shifted scatter-line is added to the previous one. If only one scatter-volume is responsible for both the QSOs to the GP- and ZO-squares, it must be included in both scatter-lines. This sectional area is displayed in picture 3, a localized region near the Swedish island of Gotland. Studies like this may be performed during actual bandopenings. The user types in the QTH-locators from all the stations he is able to pick up on the band. A dialog box is used to enter a minimum threshold value to control the graphics on the map. Scatterers which are rarely found as solutions can be suppressed in this way. This method was applied in changing from picture 2 to picture 3. Picture 2 displays all solutions (threshold "1") while in picture 3 the threshold is increased to "2".

Identification of the scatter-volume is an interesting feature but has no consequences for radio practise. AURORA's most powerful characteristic becomes available at this point: calculation of all the QTH-locator squares which are available for QSO under the conditions we have just found. These squares are cross-marked in picture 3. At first the validity of the previous found scatterer locations may be tested as at least all the QTH-locators entered via keyboard must be in a cross-marked square. If some of them are not then too high a threshold level was selected. The two QSOs to the GP- and ZO-squares now indicate to an observer in FM42f that the radio path to e.g. USSR is available.

AURORA offers some more features. Intense radio-auroras often lead to wide spread scatter areas rather than localized regions, like in this example. One may check which part of such an area must be aimed at by the antenna to establish a radio link with a particular station or locator-square. Just performing a mouse click on the map which is consistent with the location of the radio terminal desired for QSO, AURORA displays the subset of all scatterers which contribute to this particular QSO. In addition to information about maximum distances, the user is supplied with optimum antenna headings for special radio contacts.

The user may develop his own ideas on how to use the program. Only one example is given here: the analysis of back-dated events may include more than your own radio observations. Data supplied by other radio amateurs for the same observation time can also be considered, so that movements of radio-aurora can be studied on a large spatial scale.

AUROA is a public domain program. Please send a double-sided formatted diskette to DUBUS or directly to the author. Requests will be recognized only when sufficient postage (IRCs) is supplied. Please supply careful packing to assure damage-free transport. Padded envelops for multiple usage are appreciated. Requests will not be treated in sequence of arrival but in sequence of most easiest handling. Your request should refer to "DF5AI PD-Soft, Diskette 2". This diskette will also contain the latest version of QTH–LOC (graphic orientated locator program). A second diskette may be supplied for copies of further public domain software: OLGA (otimizing antenna stacking), CHIRP (high accuracy hf-predictions) and AMADEMO (demoversion of satellite tracking program AMADEUS). Please note: AURORA and OLGA are in German language.

References:

[1] Rückstreuungen ultrakurzer Wellen an Feldlinien orientierten Irregulariäten, V.Grassmann (DF5AI), DUBUS 3/1987, S. 182-189

[2] Ionospheric Scatter by Field-Aligned Irregularities at 144 MHz T.F.Kneisel (K4GFG), QST, Januar 1982