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MAXENTWDF – A COMPUTER PROGRAM FOR THE MAXIMUM ENTROPY ESTIMATION OF A WAVE DISTRIBUTION FUNCTION

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PROGRAM SUMMARY

Title of program: MAXENTWDF

Catalogue number: AAFV

Program obtainable from: CPC Program Library, Queen's University of Belfast, N. Ireland (see application form in this issue)

Computer: IBM/370 or compatible; *Installation:* Centre Inter Regional de Calcul Electronique, Orsay, France

Operating system: OS/VS

Programming language used: Fortran 77

High speed storage required: 316 K for the test run – can be varied according to choice of parameters

Number of bits in a word: 32

Peripheral other than standard input and output: magnetic disk (optional)

Number of lines in combined program and test deck: 3660

Keywords: geophysics, wave distribution function, electromagnetic wave, maximum entropy

Nature of physical problem
A random electromagnetic field can be described by a Wave Distribution Function (WDF) that specifies how the wave energy density is distributed with respect to the angular frequency ω and to the wave normal direction $\boldsymbol{K}$. Such a WDF is related to the values of the N auto and cross-power spectra of the field components by the set of integral equations:

$$s_i = \int_{x_1}^{x_2} \int_{y_1}^{y_2} a_i(x, y) G(x, y) \, \mathrm{d}x \, \mathrm{d}y;$$

$$i = 1, \ldots, N,$$

where $G(x, y)$ is the WDF, defined as positive everywhere, $a_i(x, y)$ are known kernels, and S_i are N independent quantities derived from the power spectra [1,2]. The point is to find an estimation of $G(x, y)$ from given $a_i(x, y)$ functions and from measured values $\hat{s}_i$ of the s_i.

Method of solution
The solution which is chosen is the one which maximises the entropy of the WDF and satisfies the data $\hat{s}_i$ within the limits of the errors in those data. To avoid numerical instabilities in the solution, the measured as well as the theoretical data are transformed into an orthogonal system generated from the N functions a_i. In that system, the model parameters are estimated by fitting, in the least squares sense, the M more linearly independent data ($M \leqslant N$). The validity of the solution is asserted computing prediction and stability parameters [3].

Restrictions on the complexity of the problem
The $\hat{s}_i$ are supposed to be unbiased and to have non-correlated variance errors.

Typical running time
10 s for the test run.

References
[1] L.R.O. Storey and F. Lefeuvre, Geophys. J. Roy. Astron. Soc. 56 (1979) 255.
[2] L.R.O. Storey and F. Lefeuvre, Geophys. J. Roy. Astron. Soc. 62 (1980) 173.
[3] F. Lefeuvre and C. Delannoy, Ann. Telecomm. 34 (1979) 204.