



CHAPTER III

DATA PROCESSING AND DIGITAL PROGRAMMING

Data reduction

The components H_x , H_y , H_z of magnetic field and E_x , E_y of electric field are recorded and digitized at equal time intervals into sets of original data. Each set of data must be multiplied by a correction factor according to the frequency response of the instruments and the gain of amplifier. Before the data are analysed, the following calculations may be applied, depending on their characters.

1. Data filtration

The purpose of a filter is to attenuate certain frequency components in the original data. The effect of filtration is to enhance the frequency which we are interested in for its information content without causing any phase shift that would distort the data.

A digital filter of finite length $2T$ is a sequence of number $\{h_k(t)\}$ called weighting function which we apply to the digitized continuous record $\{X_n(t)\}$, to produce the filtered output $\{s_n(t)\}$.

$$s_n = \sum_{k=-\frac{T}{\Delta t}}^{\frac{T}{\Delta t}} h_k X_{n+k}$$

2. Integration

The magnetic field measured and recorded is the field's time / as

derived, and it is necessary to find the value of the field, $Z_n(t)$

$$\begin{aligned} Z_1 &= 0 \\ Z_N &= \frac{1}{2}(X_{N-1} + X_N)\Delta t \\ Z_n &= \frac{1}{6}(X_{n-1} + 4X_n + X_{n+1})\Delta t, \quad n = 2, 3, \dots, N-1 \end{aligned}$$

Program features

There are two digital computer programs written in Basic FORTRAN IV for use on the IBM 1800 system; one for the probability calculation, the other for spectral analysis. Two subroutines for plotting the results are included in this program.

The process used in the program for calculation of probability is simple. There are three steps: read in data, calculate probability, and print results. The program listing and sample output listing of this program are given in Appendix I. The process in spectral analysis which is more complicated, will be presented by means of the flow diagram shown in Appendix II.

Card preparation

1. System control cards. Two sets of system control cards are provided by SDC for use in compilation and operation of the object deck with subroutines. One more set of system control cards is prepared by the programmer for insertion prior to the source deck at compilation.

2. Program control cards. There are three sets as follows:

Problem request cards

Filter detail cards

Selection cards for cross-spectral analysis
power

3. Input data cards

The card format of item 2 and 3 is shown in the following table

Table I Card format

Card set	Column number	Format	Description
Problem request	1-8	2A4	job identification
	9-13	I5	number of points in each input series
	14-25	F10.5	sampling time interval
	24-25	I2	output code of original data
	26-27	I2	the control number is 1 if the original data are filtered; otherwise leave blank
	28-29	I2	if the data are integrated, the control number is 1, otherwise leave blank
	30-31	I2	integrated data output code
	32-33	I2	if the data are transformed before spectral analysis, the control number is 1, otherwise leave blank
	34-36	I2	if the auto-spectrum is calculated, the control number is 1, otherwise leave blank
37-38	I2	if smooth power spectrum is calculated, the control number is 1; otherwise leave blank	

Card set	Column number	Format	Description
	39-40	I2	auto-correlation output code
	41-42	I2	power spectral output code
	43-44	I2	smooth power spectral output code
	45-46	I2	if the cross spectrum is calculated, the control ^{power} number is 1; otherwise leave blank
	47-49	I2	if smooth cross-spectrum is calculated, the number ^{power} is 1; otherwise leave blank
	50-52	I2	output code of cross-correlation
	53-54	I2	output code of cross- ^{power} spectrum
	55-56	I2	output code of smooth spectrum
	57-60	I3	number of maximum lag for spectral analysis
	61-62	I2	number of input series for cross- ^{power} spectral analysis
	63-64	I2	number of selection cards
	70-72	I3	punched 999, if it is the last problem request card
Filter detail	1-10	F10.5	the centre frequency of band pass filter
	11-20	F10.5	the half bandwidth of filter
	21-24	I4	the half length of the filter (points)
	27-28	I2	output code of weighting coefficients
	29-30	I2	output code of filtered data

Card set	Column number	Format	Description
	70-72	I3	punched 999, if it is the last filter detail card
Selection	1-2	I2	the series number of base series
	3-20	9I2	the numbers of series that cross with base series
Input	1-42	6F7.2	six values of input data
	45-54	E10.2	correction factor
	55672		input data identification

Order of cards

1. Compilation step

system control cards
 program source deck
 system control cards
 one blank card

2. Operation step

main object deck
 subroutine object deck
 system control cards
 one blank card
 data set a, b, c, ...

one blank card

Data set a, b, ..., compose of a set of cards in any sequence of the following

a. problem request card

input data

filter detail card (It is possible to have more than one filter detail card.)

b. problem request card

first series of input data

filter detail card of first series

second series of input data

filter detail card of second (As with sequence a, there may be more than one filter detail card.)

... ..

This is the card sequence for cross-power spectral analysis.

Results

The results of each calculation may be printed and/or plotted, depending on the output code value of that calculation. If it is ...

0, the results are to be suppressed

1, the results are to be plotted

2, the results are to be printed

3, the results are to be plotted and printed

The sample results of calculations are given in Appendix III.



006959