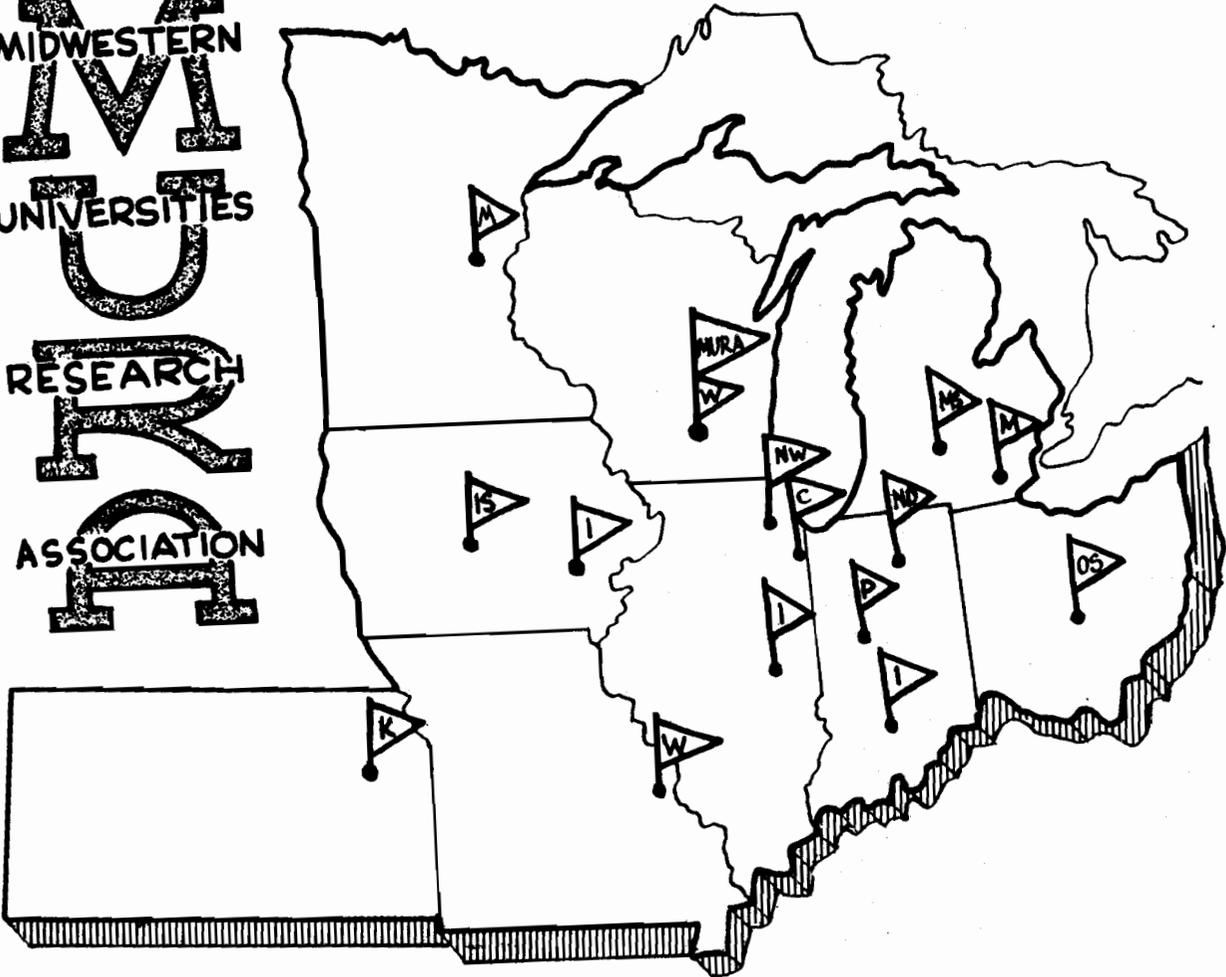


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REPORT
FRANCIS
(Program F27)
July, 1960

NUMBER 582
Computer Program
(Internal)

FRANCIS
(Program F27)

G. A. Westlund

This program, suggested by G. Parzen, provides a Fourier analysis of fields measured on the two-way model. The input consists of the fields (pre-recorded on tape) and certain control parameters (on cards). Outputs available (under sense switch control) are printing, plotting, tape recording, and card punching.

The analysis is performed in floating point arithmetic with the following equations:

$$a_j = \frac{1}{P} \left[f_{\theta_0} \cos \frac{2\pi(-\theta^*)jz}{P} + (1+2F-F^2) f_{\theta_0+I} \cos \frac{2\pi(I-\theta^*)jz}{P} \right. \\ \left. + F^2 f_{\theta_0+I+1} \cos \frac{2\pi(I+1-\theta^*)jz}{P} \right]$$

$$+ \frac{2}{P} \sum_{i=\theta_0+1}^{\theta_0+I-1} f_i \cos \frac{2\pi(i-\theta_0-\theta^*)jz}{P}$$

$$b_j = \frac{1}{P} \left[f_{\theta_0} \sin \frac{2\pi(-\theta^*)jz}{P} + (1+2F-F^2) f_{\theta_0+I} \sin \frac{2\pi(I-\theta^*)jz}{P} \right. \\ \left. + F^2 f_{\theta_0+I+1} \sin \frac{2\pi(I+1-\theta^*)jz}{P} \right]$$

$$+ \frac{2}{P} \sum_{i=\theta_0+1}^{\theta_0+I-1} f_i \sin \frac{2\pi(i-\theta_0-\theta^*)jz}{P}$$

$$c_j = \sqrt{a_j^2 + b_j^2}, \quad c_0 = \frac{a_0}{2}$$

$$\beta_j = \frac{b_j}{|b_j|} \arccos \frac{a_j}{c_j}, \quad \beta_0 = 0$$

over the interval $\theta_0 \leq \theta \leq \theta_0 + P$, and about the angle θ^* , where f is the field at any integral angle θ (in degrees). The integer and fractional parts of P are denoted by I and F .

TAPE INPUT

A current (updated) MISHMASH tape is mounted on tape drive 2. An erasable tape to receive output is mounted on tape drive 3.

The MISHMASH tape contains 8 blocks of 126 records each. The block numbers are:

1122
1525
0119
0405
1729
0934
0328
0826

Each record contains 45 field values at angle numbers 1 to 45 (degrees) measured along one radius. The 126 radii available are 100 to 225 centimeters.

CARD INPUT

The control parameters are entered on a standard MURA-FORTRAN agendum sheet (see attachment). They are:

<u>Address</u>	<u>Parameter</u>	
11	Run ID	integer ≤ 32767 .
1	Block no.	contains θ_0 .
2	r_1	} Analysis is performed at all radii from r_1 to r_2 inclusive.
3	r_2	
4	θ_0	$1 \leq$ integer angle number ≤ 45 .
5	θ^*	not restricted to integers.
6	P	ditto, $P \leq 360$ degrees.
7	k	= 9.3 if not entered.
8	j_{\max}	highest harmonic desired.
9	Z	= 1 if not entered.
10	Spread	plot shrink factor = 4 if not entered.

A spread of 1 will cause plotting to cover an entire printed page. A value of N will vertically shrink the plot to cover $1/N$ of the page.

PRINTED OUTPUT

For each radius, the printout includes the value of r , the field values from θ to $\theta_0 + P$, desired harmonics of a , b , c , and β , and values of $a_j / (r/100)^k$, $b_j / (r/100)^k$, $c_j / (r/100)^k$.

The printout can be suppressed by setting sense switch 6 up.

PLOTTING

Each harmonic of $c_j / (r/100)^k$ and β_j are plotted against r on a separate page. Plotting can be suppressed by setting sense switch 3 up.

TAPE OUTPUT

Tape 3 receives one record per radius from r_1 to r_2 . Each record contains 100 words. The first 50 contain up to 50 harmonics of $(c_j \times 10^3) / (r/100)^k$. Harmonics above j_{\max} are filled in with zeros. The second 50 contain harmonics of β_j with zeros for harmonics not requested. The tape output cannot be suppressed.

PUNCHED CARD OUTPUT

The card output is designed to be used as input to XMASH (Program Fl6 - method no. 6). The first card contains the address 10 and the value 6, the second card is an "end data" card. The remainder of the cards contain values of $(c_j \times 10^3) / (r/100)^k$ with addresses in the range 101 to 1150, and values of β_j with addresses in the range 1201 to 2250. Punching can be suppressed by setting sense switch 5 up.

SENSE SWITCH SETTINGS

- | | |
|---|---|
| 1 | down. |
| 2 | down. |
| 3 | down-normal, up-eliminates plotting. |
| 4 | down-normal, up-prints partial sums of a_j for debugging. |
| 5 | down-normal, up-eliminates punching. |
| 6 | down-normal, up-eliminates printing. |

MEMORANDUM

TO: FRANCIS users
FROM: G. A. Westlund
DATE: September 8, 1960
SUBJECT: Modification of FRANCIS (Computer Program F27)

The capacity of harmonics computable has been increased from 50 to 450. If M_{\max} is equal to or less than 50, tape 3 will continue to contain records of 100 words each. If M_{\max} is greater than 50, each record will contain $2 \times M_{\max}$ words.

This memo should be attached to the original FRANCIS report no, MURA-582.