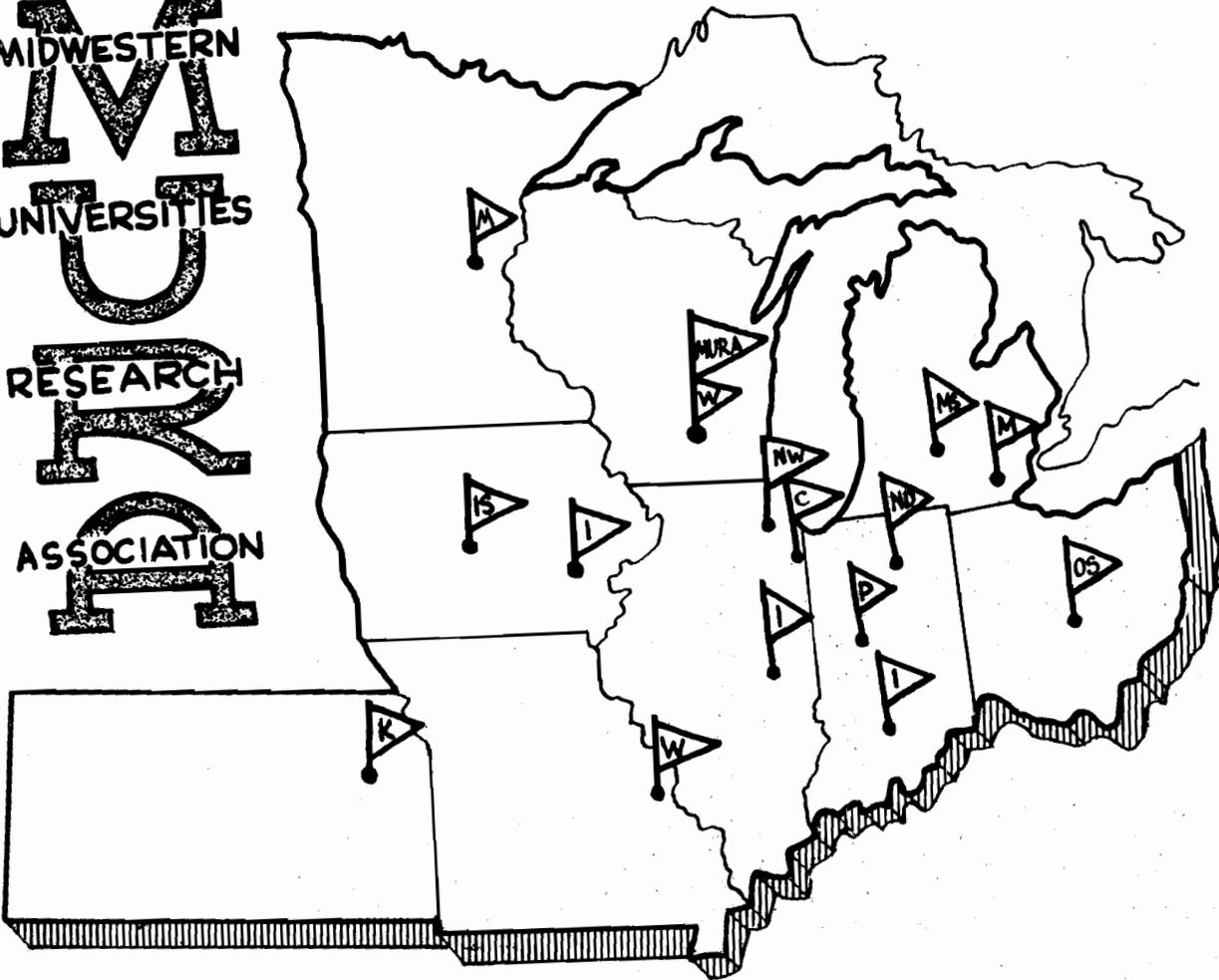


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**REPORT**

CHANNEL FIVE  
(Problem 120)  
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(IBM Program)

CHANNEL FIVE  
(Problem 120)

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The following notes are presented as a guide to the users of the program known as "CHANNEL FIVE" (Problem 120).

CHANNEL FIVE is a modification of the program WELL TEMPERED FIVE (Problem 46) and differs from WELL TEMPERED FIVE only in its mode of output. CHANNEL FIVE permits the user to plot results in a variety of ways on the IBM cathode ray tube display unit and to record the plot on 35 mm film. The conventional output mode on the printer is simultaneously available or it can be suppressed if it is so desired.\*

The type of figure desired is determined by a parameter entered on the agendum sheet. This parameter is called the Scope Word, hereafter designated as SW; it is an integer and has eleven possible values ranging from -3 to +7. The figure resulting from each of the eleven values of SW is described below.

SW = -3: x and y are plotted as a function of  $\Theta$ . The x points appear bright and the y points appear dim. A horizontal and a vertical axis will appear; the vertical axis will appear at the extreme left of the figure,  $\Theta = 0$ , and the horizontal axis will pass through the center of the figure, x and y = 0.

The frequency of plotting, for both x and y, is controlled by a parameter,  $N_{SCP}$ , which is entered on the agendum sheet as an integer. x and y are plotted every  $N_{SCP}$  Runge-Kutta steps. The horizontal separation of points (i. e., the

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\*Achieved by giving a sufficiently large value to  $N_P$ ,  $N_{IP}$ ,  $N'_{IP}$  on the WELL TEMPERED FIVE agendum sheet.

scale of the  $\Theta$  axis) is controlled by another integer parameter  $N_T$ , which is equal to the number of intervals desired along the horizontal axis. The program automatically scales the interval size so that the  $N_T$  intervals just span the  $\Theta$  axis. After  $N_T$  x-y pairs of points have been plotted the film is advanced one frame, new axes are drawn, and the next  $N_T$  x-y pairs of points are plotted and so forth until the end of the problem. Each film frame is numbered in the upper right hand corner, the first frame having the number 1, the next 2, etc.

Scale factors for x and y,  $x_{SF}$  and  $y_{SF}$ , must be entered on the agenda sheet as floating point numbers. The program plots the integer part of  $\frac{x}{x_{SF}}$  and  $\frac{y}{y_{SF}}$ . The top and bottom of the figure correspond to +511 and -512, respectively,

for  $\frac{x}{x_{SF}}$  and  $\frac{y}{y_{SF}}$  (integer part). Points  $\frac{x}{x_{SF}}$  and  $\frac{y}{y_{SF}}$  which fall outside of the

closed interval (-511, 511) will appear with the coordinate value -512\* if Sense Switch 4 is UP and if Sense Switch 4 is DOWN they will be plotted as

$\pm \left\lfloor \frac{x}{x_{SF}} \right\rfloor \text{ (integer part) mod } 5 \pm 2$  where the sign is the same as the sign of x, and similarly for y. Thus, if the integer part of  $\frac{x}{x_{SF}}$  is -513 the point will

appear at the bottom edge of the picture if SS4 is UP and it will appear one

unit below the horizontal axis (-1) if SS4 is DOWN. Similarly, if the integer

part of  $\frac{x}{x_{SF}}$  is +513 the point will appear at the bottom edge of the picture if

SS4 is UP, and it will appear one unit above the horizontal axis if SS4 is DOWN.

The film frame immediately preceding the series of frames on which the points are plotted will have the Problem Number (120) and Identification Number recorded on it.

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\*The bottom edge of the figure.

SW = -2: y only is plotted as a function of  $\Theta$ . Otherwise the figure format and rules pertaining to it are identical to those described for SW = -3.

SW = -1: x only is plotted as a function of  $\Theta$ . Otherwise the figure format and rules pertaining to it are identical to those described for SW = -3.

SW = 0: All scope output is suppressed.

SW = 1: A phase plot,  $p_x$  vs x, will be made, the points appearing bright. The frequency of plotting is controlled by the parameter  $N_{SCP}$  as described under SW = -3. The points appear as integers, the first point plotted being recorded as 0, the next as 1, the next as 2, etc.. The actual position of the point (x,  $p_x$ ) coincides with the center of the right-most digit of the integer.

The center of the scope corresponds to  $x = 0$ ,  $p_x = 0$ , with horizontal and vertical axes being drawn through this center point. x is scaled by the floating point parameter  $x_{SF}$  and  $p_x$  is scaled by the floating point parameter  $p_{xSF}$ . Again, the integer part of the scaled quantities  $\frac{x}{x_{SF}}$ ,  $\frac{p_x}{p_{xSF}}$  is plotted with the x axis (horizontal) spanning the interval (-512, 511) and the  $p_x$  axis (vertical) spanning the interval (-512, 511). Scaled quantities falling outside the interval (-511, 511) are plotted modularly or non-modularly according to the setting of Sense Switch 4 as described in the section for SW = -3.

The Problem Number (120) and Identification Number appear in the upper right hand corner of the figure. There is no automatic advance of the film but manual advancement of the film by one frame is achieved by putting Sense Switch 5 UP until the film advance has been executed, and then returning it to the DOWN position.

SW = 2: A phase plot,  $p_y$  vs  $y$ , will be made, the points (integers) appearing dim. The figure format and rules pertaining to it are otherwise like those described above for  $SW = 1$ , with the scale factor for  $p_y$  being designated by  $P_{ySF}$ .

SW = 3: Two phase plots,  $p_x$  vs  $x$  and  $p_y$  vs  $y$ , are made simultaneously, with the  $p_x$  vs  $x$  points (integers) appearing bright and the  $p_y$  vs  $y$  points (integers) appearing dim. Otherwise the figure format and rules pertaining to it are as described above for  $SW = 1$ .

SW = 4: A plot of  $y$  vs  $x$  will be made. It has all of the properties of the phase plot  $p_x$  vs  $x$  with  $y$  playing the role of  $p_x$  (and  $y_{SF}$  replacing  $p_{xSF}$ ).

SW = 5: A phase plot,  $p_x$  vs  $x$ , will be made with unnumbered points. Otherwise the figure format and rules pertaining thereto are as described for  $SW = 1$ .

SW = 6: A phaseplot,  $p_y$  vs  $y$ , will be made with unnumbered points. Otherwise the figure format and rules pertaining thereto are as described for  $SW = 1$ .

SW = 7: Two phase plots,  $p_x$  vs  $x$  and  $p_y$  vs  $y$ , will be made with unnumbered points. Otherwise the figure format and rules pertaining thereto are as described for  $SW = 1$ .

At the beginning of each problem the film is automatically advanced one frame. This can be suppressed by setting the integer parameter  $FF1 = 8338276352$ . If, in a series, it is subsequently desired to resume the automatic film advance at the start of the problem the user must set  $FF1 = 8321499160$ .

The automatic advancement of the film in figures --  $x$  vs  $\Theta$ ;  $y$  vs  $\Theta$ ;  $x$  vs  $\Theta$  and  $y$  vs  $\Theta$  -- can be suppressed by specifying an integer parameter,  $FF2 = 8338276352$ , on the agendum sheet as indicated on the attached sample agendum sheet. If it is desired to resume automatic film advancement in a series of runs where it has been previously suppressed, then the user must set  $FF2 = 8321499160$ .

It should be noted that in all figures points referring to  $x$  or  $p_x$  are presented as bright points and points referring to  $y$  or  $p_y$  are presented as dim points. This distinction is not clearly apparent on the visual display but it does show up on the film record. In a  $y$  vs  $x$  plot the points (integers) are presented as bright points.

The maximum number that can be assigned to a point on a phase plot is  $2^{35} - 1 = 34,359,738,367$ .

In order to guarantee that all plotted points remain within the scale of the figure the parameters  $x_{SF}$ ,  $y_{SF}$ ,  $p_{xSF}$  and  $p_{ySF}$  must be chosen such that the following inequalities are satisfied at all times:

$$\left| \frac{x}{x_{SF}} \right| < 512, \quad \left| \frac{y}{y_{SF}} \right| < 512$$
$$\left| \frac{p_x}{p_{xSF}} \right| < 512, \quad \left| \frac{p_y}{p_{ySF}} \right| < 512$$

The parameters  $SW$ ,  $N_{SCp}$ ,  $N_T$ ,  $x_{SF}$ ,  $y_{SF}$ ,  $p_{xSF}$  and  $p_{ySF}$  will appear on the initial print;  $SW$  appears on line 27;  $N_{SCp}$  and  $N_T$ , respectively, appear on line 28;  $x_{SF}$ ,  $y_{SF}$ ,  $p_{xSF}$  and  $p_{ySF}$ , respectively, appear on line 29.

On the following page a sample agendum sheet is shown. This agendum sheet is to be attached by staples to the WELL TEMPERED FIVE agendum sheet.

**CHANNEL FIVE AGENDUM SHEET  
(PROBLEM 120)**

This agendum sheet must be attached by staples to the associated WELL TEMPERED FIVE AGENDUM.

Parameter	Address	Value		Remarks
SW	3186			Scope Word
N <sub>SCP</sub>	3191			N <sub>SCP</sub> Runge-Kutta steps per plot
N <sub>T</sub>	3192			N <sub>T</sub> = # of intervals on $\theta$ axis
FF1	2984			= 8338276352 to suppress film advance
FF2	8112			= 8321499160 to resume film advance
x <sub>SF</sub>	3187	n	exp	x scale factor
y <sub>SF</sub>	3188			y scale factor
p <sub>xSF</sub>	3189			p <sub>x</sub> scale factor
p <sub>ySF</sub>	3190			p <sub>y</sub> scale factor

**SENSE SWITCH 4**

Non-Modular	UP	
Modular	DOWN	

Notes: SW = -3, x, y vs  $\theta$ ; SW = 2, y vs  $\theta$ ; SW = -1, x vs  $\theta$ ; SW = 0, nothing; SW = 1, p<sub>x</sub> vs x, as numbers; SW = 2, p<sub>y</sub> vs y as numbers; SW = 3, p<sub>x</sub> vs x, p<sub>y</sub> vs y as numbers; SW = 4, y vs x as numbers; SW = 5, p<sub>x</sub> vs x as points; SW = 6, p<sub>y</sub> vs y as points; SW = 7, p<sub>x</sub> vs x and p<sub>y</sub> vs y as points.

To remain within scale satisfy

$$\left| \frac{x}{x_{SF}} \right| < 512, \quad \left| \frac{y}{y_{SF}} \right| < 512, \quad \left| \frac{p_x}{p_{xSF}} \right| < 512, \quad \left| \frac{p_y}{p_{ySF}} \right| < 512$$