MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT MAC

Artificial Intelligence Memo. No. 128. March 1967.
Hardware and Program Memo.

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SERVO is intended as an engineering and programming analyzing and debugging aid for use with devices connected through the input and output multiplexers to the PDP-6. Channel numbers and values to output, as well as some other numeric arguments, are in octal. Only the frequency of K, N, Q & W, the duration of I & U, and the argument of Z are decimal. Commands are single letters, as follows:

A assign input channel specified by first argument to output channel specified by second argument, so that value read on input is sent out on output.
- in input channel deassigns pair
- in output ~~pair~~ channel types out the value being outputted, and, if the pair is being deassigned, the current value is maintained as output (result is same as with O command)

It is possible to assign one input channel to more than one output channel, and also to assign more than one input channel to one output channel, which will result in an alternation of outputted value among the various inputs.

B complement displaying of X & Y zero-base lines

C connect generated waveform to output channel

D set display parameters
units digit (vertical axis parameter)
- Ø display value on viewed channel (position)
- 1 display first derivative of value on viewed channel (velocity)
- 2 display second derivative of value on viewed channel (acceleration)
- 3 display value of generated waveform minus value on viewed channel (error)

tens digit (horizontal axis parameter)
- Ø display versus time
- 1 display versus value of generated waveform

H set horizontal sweep parameters (All H arguments are octal.)
A data point is found each time the viewed channel is sampled, ~~wh~~ which occurs at 48Ø cps. Arguments denote:
first argument -- number of data points to disregard per data point displayed (normally Ø)
second argument -- number of horizontal deflection units by which to increment per data point displayed (normally 1)
third argument -- number of data points by which to delay sweep after being automatically triggered by generated waveform increasing from its base value (normally Ø)

M smooth vertical co-ordinate of each data point by averaging it with the number of previous points given by the argument, up to 7 (normally Ø)

O output a value specified by the first argument on a channel specified by the second argument; a decimal point in either argument ceases the outputting on the given channel
Multiple O commands to one channel merely update the value being outputted. It is suggested that no channel be A'd and O'd simultaneously, since this will cause unusual results. For example, if a channel is A'd to, Oing it will have only momentary effect.

V view input channel

Y change Y deflection parameters
Value displayed is equal to value calculated times (2 to the power (first argument minus eight)). This parameter is normally 6 for position (DØ), resulting in raster height = 1ØØØØ pot units; and normally 1Ø, octal, for other functions, resulting in half of raster height = 1ØØØ pot units per 1/48Ø second (or less, depending on first H argument) for velocity (D1); = 1ØØØ pot units per 1/48Ø second per 1/48Ø second (again depending on first H argument) for acceleration (D2); = 1ØØØ pot units for error (D3).
Bottom of display raster is set equal to second argument in pot units, for position only. (normally Ø)

Z number of periods of generated waveform to display before triggering sweep; argument in decimal (normally 1)

generated waveforms:

I impulse
K kludge wave (sum of two square waves 9Ø degrees out of phase)
N sine wave
Q square wave
U upside-down (negative-going) impulse
W triangular wave

first argument -- base (dc) value (octal)
second argument -- amplitude (base to peak) value (octal)
third argument -- frequency (decimal, in cycles per second), except for I & U (duration, decimal, seconds)

RUBOUT dismisses any command partially typed, returns to expecting a letter command

SPACE, CR these terminate arguments and also may be typed at letter command level with no command effect

. decimal point in decimal arguments, special effects in octal arguments of A and O; otherwise ignored

XXX typed out by program in response to RUBOUT or when command does not make sense; errors may be:

A -- no room left in output table (initially 31 channels plus one for C)
tried to reset non-active channel pair
tried to type out value on non-assigned channel pair

N -- frequency too large (153 cps is, 152 is not)

O -- no room left in output table
tried to reset non-active channel

examples:

to output a constant value 3ØØØ (octal) on channel 23

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O3ØØØ 23
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to output a 2Ø cps sine wave centered on 1ØØ and varying between 4Ø and 14Ø on channel 24, and display the difference between this and a hypothetical response found on channel 124

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N1ØØ 4Ø 2Ø C24 V124 D3
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to cause the value on input channel 1Ø5 to be outputted on channel 15

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A1Ø5 15
```

to fix the value on output channel 15 to whatever it is at this moment, and type out this value

```
A.1Ø5 1.5
```

to cease the outputting of this constant value on channel 15 (so it will drift free unless it has been C'd or something new A'd to it)

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O 15.
```

	output channel	command read input channel	position input channel
M-B S	54	254	46
S	55	255	47
1A	56	100,256	50
1B	57	101,257	51
2A	60	102,260	52
2B	61	103,261	53
3A	62	104,262	54
3B	63	105,263	55
4A	64	106,264	56
4B	65	107,265	57
grip	66	266	64
tilt	67	267	61
extend	70	7,270	62
rotate	71	6,271	63
roll	72	5,272	65
yaw	73	4,273	66
TDR	74	3,274	60
horiz	75	2,275	[67,70],71
vert	76	1,276	[75,76],77
swing	77	0,277	[72,73],74

[ ] = high resolution