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903

Volume 2: PROGRAMMING INFORMATION
Part 2: PROGRAM DESCRIPTIONS
Section 13: QATAN (B. 10)

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Chapter 1: DESCRIPTION

1. 1 INTRODUCTION.

1. 1. 1 Purpose.

To calculate

$$t = (1/\pi) \tan^{-1}(x/y)$$

where $-1 \leq x < +1$
 $-1 \leq y < +1$

1. 1. 2 Form of Distribution.

The program is distributed as a machine-code tape for input by SIR or by T2.

1. 1. 3 Method of Use.

The routine is assembled as a sub-routine of the user's program and used as a sub-routine. It can be run at any program level and in any store module.

1. 1. 4 Accuracy.

The maximum error is 2^{-15} ($\approx .00003$).

1. 2 FUNCTIONS.

1. 2. 1 Notation.

x, y, t are as defined in 1. 1. 1.

1. 2. 2 Number Type.

All numbers must be treated by the programmer as pure fractions. To enable this to be done QATAN calculates

$$(1/\pi) \tan^{-1}(x/y)$$

Note, therefore, that on exit the accumulator holds the value of an angle as a fraction of π radians (180°).

1. 2. 3 Entry and Exit.

(for assembly by SIR.) (for translation by T2.)

Entry: place x in QATAN+89	89;N
" y in QATAN+90	90;N
"link in QATAN	0;N
jump to QATAN+1	1;N

(where N is the number of
the block)

Exit: the result is in the accumulator

x and y are not affected.

1. 2. 4 Identifiers.

QATAN must be declared as a global identifier
in all blocks of a SIR program which refer to it.On the library tape a mnemonic label and
identifier list are separated from the coding by several inches of blank
tape: the mnemonics must not be loaded into the tape reader if the tape
is to be translated by T2.

1. 3 ERROR INDICATIONS.

If $x=y=0$ blank tape is output continuously.

1. 4 METHOD USED.

a) The program computes

$$a = \begin{cases} |x/y| & \text{if } |x/y| < 1 \\ |y/x| & \text{if } |x/y| \geq 1 \end{cases}$$

and applies the transformation

$$Z = \frac{a - (\sqrt{2} - 1)}{(3 - 2\sqrt{2}) a + (\sqrt{2} - 1)}$$

Note $|Z| < 1$

b) $S = 1/\pi \tan (\sqrt{2} - 1) Z$

is calculated by a Chebyshev series.

c) The final result is found by forming

$$u = (1/\pi) \tan^{-1} |x/y| = \begin{cases} \frac{1}{8} + S & \text{if } |x/y| < 1 \\ \frac{1}{2} - (\frac{1}{8} + S) & \text{if } |x/y| \geq 1 \end{cases}$$

and the value found according to the table below:

	$y \geq 0$	$y < 0$
$x/y \geq 0$	u	$u - 1$
$x/y < 0$	$-u$	$1 - u$

1.5 TIME TAKEN.

The time taken depends on the values of x/y and of y .

The maximum time is about 3.2 milliseconds.

1.6 STORE USED.

128 consecutive store locations and the appropriate B-register.