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RESEARCH IN ALGEBRAIC MANIPULATION(U) MASSACHUSETTS  
INST OF TECH CAMBRIDGE LAB FOR COMPUTER SCIENCE  
J MOSES 26 JUN 83 AFOSR-TR-84-0036 AFOSR-80-0250

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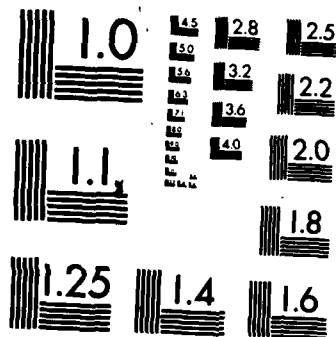
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19. ABSTRACT (Continue on reverse if necessary and identify by block number) <p>This was a transitional year. One in which the investigators phased down research on the integration of algebraic functions (described in last year's report), and one in which they began a new line of research on the solution of ordinary differential equations in closed form.</p> <p>Barry Trager continued his doctoral thesis research on the integration of algebraic function while working at IBM Research in Yorktown Heights. The report on this work previously submitted still gives a very good account of this line of research. The approach he has taken is to determine the minimal extension field in which the integral can be expressed. This can lead to a tremendous improvement in both the running time and the size and complexity of the expression that is produced.</p> <p>(CONTINUED)</p>				
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ITEM #11, TITLE: RESEARCH IN ALGEBRAIC MANIPULATION,  
1 JULY 81 - 30 JUNE 82.

ITEM #19, ABSTRACT, CONTINUED: The major effort in the last few months of the period was on the solution of ordinary differential equations (ODEs) by a Japanese visitor, Professor Shunro Watanabe. Professor Watanabe has begun to develop a subsystem of MACSYMA that solves ODEs by converting them to P-functions, originally studied by Riemann. One example of this approach to solving ODEs is given within. One goal of this work is to solve a large percentage of Kamke's equations using this general approach.

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## PROGRESS REPORT FOR THE 1981-82 PERIOD

*This document indicates*

This was a transitional year. One in which we phased down research on the integration of algebraic functions (~~described~~ <sup>was phas'd down</sup> in last year's report), and ~~one in which we began~~ a new line of research on the solution of ordinary differential equations in closed form, <sup>begin.</sup>

Barry Trager continued his doctoral thesis research on the integration of algebraic function while working at IMB Research in Yorktown Heights. The report on this work previously submitted still gives a very good account of this line of research. The approach he has taken is to determine the minimal extension field in which the integral can be expressed. This can lead to a tremendous improvement in both the running time and the size and complexity of the expression that is produced.

The major effort in the last few months of the period was on the solution of ordinary differential equations (ODEs) by a Japanese visitor, Prof. Shunro Watanabe. Professor Watanabe has begun to develop a subsystem of MACSYMA that solves ODEs by converting them to P-functions, originally studied by Riemann. One example of this approach to solving ODEs is given below. One goal of this work is to solve a large percentage of Kamke's equations using this general approach.

PALGS FASL DSK SWATAN being loaded  
 Loading done  
 we solve

$$y = (x - 1)^{1/4} P \begin{bmatrix} 0 & 1 & INF \\ 1 & 1 & 1 \\ - & - & - \\ 3 & 2 & 12 \\ 0 & 0 & 1 \\ & & 4 \end{bmatrix} (x)$$

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$$y = \frac{K1 T^{1/4} (2 \sqrt{T^2 + T + 1} + \sqrt{3} (T + 1))^{1/4} (x - 1)^{1/4}}{(T - 1)^{3/12}}$$

$$+ \frac{K2 T^{1/4} (\sqrt{3} (T + 1) - 2 \sqrt{T^2 + T + 1})^{1/4} (x - 1)^{1/4}}{(T - 1)^{3/12}}$$

where t=x^(1/3)  
 Time= 13449 msec.

$$(D8) \frac{K1 T^{1/4} (2 \sqrt{T^2 + T + 1} + \sqrt{3} (T + 1))^{1/4} (x - 1)^{1/4}}{(T - 1)^{3/12}}$$

$$+ \frac{K2 T^{1/4} (\sqrt{3} (T + 1) - 2 \sqrt{T^2 + T + 1})^{1/4} (x - 1)^{1/4}}{(T - 1)^{3/12}}$$

Time= 15278 msec.  
 (D9)

BATCH DONE

(C10) closefile(buffer,save);

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(D2)

[DSK. SWATAN]

(C3) showtime: true\$  
Time= 5 msec.

(C4) batch(examp1,12);

Kamke example 406

(C5) k406: 16\*(X-3-1)^2\*DIFF(Y,X,2)+27\*X\*Y=0;  
Time= 41 msec.

$$(D5) \quad 16 (X - 1)^2 \frac{d^2 Y}{dX^2} + 27 X Y = 0$$

(C6) k406t: 48\*x^2\*(x-1)^2\*diff(y,x,2)+32\*x\*(x-1)^2\*diff(y,x)+9\*x\*y=0;  
Time= 50 msec.

$$(D6) \quad 48 (X - 1)^2 X \frac{d^2 Y}{dX^2} + 32 (X - 1)^2 X \frac{dY}{dX} + 9 X Y = 0$$

(C7) loadfile(pmain\_fasl);

PMAIN FASL DSK SWATAN being loaded  
Loading done  
Time= 426 msec.

(D7) DONE

(C8) lode2(k406t);

$$\text{we solve } \frac{d^2 Y}{dX^2} + \frac{2}{3X} \frac{dY}{dX} + \frac{3Y}{16X^3 - 32X^2 + 16X} = 0$$

SOLVE FASL DSK MACSYM being loaded  
Loading done

PHYPGM FASL DSK SWATAN being loaded  
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the type is hypergeometric  
the solution may be written by Riemann's P-functions as follows

$$y = P \begin{bmatrix} 0 & 1 & \text{INF} \\ 1 & 3 & 1 \\ 3 & 4 & 3 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{bmatrix} (x)$$

PHGNP FASL DSK SWATAN being loaded  
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