



Doctoral Thesis

Algorithmisches Differenzieren

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Algorithmisches Differenzieren

ABHANDLUNG

zur Erlangung
des Titels eines Doktors der Mathematik
der
EIDGENÖSSISCHEN TECHNISCHEN HOCHSCHULE
ZÜRICH

vorgelegt von

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dipl. Math. ETH
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Prof. Dr. P. Henrici, Korreferent

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Abstract

A new method to compute derivatives, called algorithmic differentiation, is presented. It is in a certain sense intermediate between numerical and formal differentiation, but it avoids their shortcomings. (Lack of arithmetic precision, respectively exponential increase in the length of the formulae.)

A program to compute the value of a funktion f is transformed by algorithmic differentiation in a new program which computes simultaneously f' and f .

The underlying ideas are that a machine with the help of the four operations $+$, $-$, $*$, $/$ and the relations $=$, \neq , $>$, \geq , \leq , $<$ can only represent piecewise fractional relational function.

The second idea is that the problem can be reduced by the chain rule to differentiation of expressions with only two operands.

The simultaneous computation of f' and f requires at most 6 times as many arithmetic operations as what is required to compute f alone and the whole computational effort is on the average increased by a factor 3.