A Code Generator for Automatic Differentiation of Algorithms Written in C/C++

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Extended Abstract

We present a package for generating C-code for automatic differentiation of algorithms written in C/C++.

Our package is an extension for the ADOL-C package written by Andreas Griewank, David Juedes and Jean Utke.[1] This package provides a library of functions to be used from other C/C++ programs to evaluate the derivatives.

The ADOL-C package has to be linked and used with the actual application in order to get a value for a derivative. Our aim was to extend it to generate a source code of the derivative.

We based our work on the fact that a formula can be broken down into a list of operations where each operation is a basic operation.

By analyzing the original program as a sequence of arithmetic operations and library functions we obtain a code list representation of the program. This code list is then used to build the derivative code by applying the chain rule.

We used the tracing capability of the original package, in order to break the calculation into a code list. The tracing works by running through the code and marking each operation and the operands which are used on tapes (buffers or files).

After the tracing is done, we read the tapes and for each operation generate the code that calculates the value of the operation and its derivatives.

Our package works as a compiler that produces a new source code in C that contains a function for the calculation of the derivatives of a function. The result code can than be linked to any program it is needed in and be used independently form our package.

This package is in the very first stage of the development and much work is still to be done, mainly in the field of code optimization and higher orders of derivatives.

[1] see the documentation for the package - "ADOL-C: A Package for the Automatic Differentiation of Algorithms Written in C/C++" , Version 1.5, December 1993. ftp: info.mcs.anl.gov:pub/ADOLC.