1077-86-2435   **A A Abokhodair*** (`akwahab@kfupm.edu.sa`), KFUPM, Box 448, ESD, Dhahran, EP 31261, Saudi Arabia. *Differentiation Tools in Geoscience Computation.*

The need for numerical differentiation arises in a wide range of geosciences applications. We distinguish here between two types of differentiation problems: the first is the differentiation of functions available in closed form without determining their derivatives explicitly; this type of problem is referred to here as derivative approximation. The second problem is that of estimating the gradients of digital data or digital differentiation. In this paper, we describe two methods for these two different types of differentiation problems, semiautomatic differentiation (SD) and least square digital differentiation filters (LSDD). SD is based on complex calculus and provides an effective way of approximating derivatives of analytic functions similar to automatic differentiation. The SD method is shown to be superior to finite difference (FD) schemes in accuracy, robustness and ease of implementation. Unlike FD-based filters, LSDD filters are low-pass, maximally linear near the DC frequency and have a low noise reduction ratio. Based on theoretical arguments, direct comparisons with ideal low-pass filters and results of numerical experiments we show that these digital differentiators are optimum in robustness, noise reduction and moment preservation of input signal. (Received September 22, 2011)