An Approach to the Application of Shift-and-add Algorithms on Engineering and Industrial Processes

J. L. Sánchez-Romero [1], A. Jimeno-Morenilla[1], R. Molina-Carmona [2], J. Pérez-Martínez[1]

[1] Department of Computing Technology

[2] Department of Computer Science and Artificial Intelligence

University of Alicante, Apdo. Correos 99, 03080 Alicante, Spain.

Phone: +34 965 90 34 00 Fax: +34 965 90 96 43

sanchez@dtic.ua.es, jimeno@dtic.ua.es, rmolina@dccia.ua.es, jperez@dtic.ua.es

Abstract

Different kinds of algorithms can be chosen so as to compute elementary functions: polynomial approximations, methods based on arithmetic-geometric mean, shift-and-add algorithms, and so on. Among all of them, it is worthwhile mentioning the shift-and-add algorithms due to the fact that they have been specifically designed to be very simple and to save computer resources. In fact, the almost only operations usually involved on these methods are additions and shifts, which can be easily and efficiently performed by a digital processor.

Shift-and-add algorithms allow fairly good precision with low cost iterations. The most famous algorithm belonging to this type is CORDIC. It has been widely studied in the related literature. Despite its simplicity, CORDIC has a drawback which consists in the scaling factor added after each one of the iterations performed. To compensate this scaling factor, several approaches have been proposed. Another, more recent, shift-and-add algorithm is BKM. It was originally designed to compute complex exponential and logarithm. Although BKM iterations are not as simple as the ones of CORDIC, it has the advantage of working with complex operands and of not to add any scaling factor. CORDIC and BKM algorithms both have the capability of approximating a wide variety of functions with the only help of a slight change on their iterations.

In this paper, we will analyze the requirements of some engineering and industrial problems in terms of type of operands and functions to approximate. Then, we will propose the application of shift-and-add algorithms based on CORDIC and BKM to these problems. We will make a comparison between the different methods applied in terms of the precision of the results and the number of iterations required.