Abstract

Discrete Walsh transform is an orthogonal transform often used in

spectral methods for different applications in signal processing and logic

design. FFT-like algorithms make it possible to efficiently calculate the

discrete Walsh spectrum. However, for their exponential complexity, these

algorithms are practically unsuitable for large functions. For this

reason, a Binary Decision Diagram (BDD) based recursive method for Walsh

spectrum calculation has been introduced in [4]. A disadvantage of this

algorithm is that the resulting Multi-Terminal Binary Decision Diagram

(MTBDD) representing the Walsh spectrum for f can be large for some

functions. Another disadvantage turns out if particular Walsh coefficients

are to be computed separately. The algorithm always calculates the entire

spectrum and, therefore, it is rather inefficient for applications where a

subset of Walsh spectral coefficients, i.e., the pruned Walsh spectrum, is

required. In this paper, we propose another BDD-based method for Walsh

spectrum calculation adapted for application where the pruned Walsh

spectrum is needed. The method takes advantage of the property that, for

most switching functions, the size of a BDD for f is usually quite a bit

smaller than the size of the MTBDD for the Walsh spectrum. In our method,

a MTBDD representing the Walsh spectrum is not constructed. Instead, two

additional fields are assigned to each node in the BDD for the processed

function f. These fields are used to store the results of intermediate

calculations. Pairs of spectral coefficients are calculated and stored in

the fields assigned to the root node. Therefore, the calculation

complexity of the proposed algorithm is proportional to the size of the

BDD for f whose spectrum is calculated. Experimental results demonstrate

the efficiency of the approach.