A HIGH THROUGHPUT SYSTOLIC IMPLEMENTATION OF THE SECOND ORDER RECURSIVE FILTER

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Abstract

There have been many 2D (two–dimensional) VLSI structures introduced in the literature for 1D (one–dimensional) recursive digital filters with high throughput. The technique applied for the implementations is mainly based on block–state–variable filter descriptions. This paper introduces a high throughput systolic implementation of direct form second order recursive filters. The systolic structure has the advantages of regularity and modularity over implementations of the block–state–variable form, as it is regular and an n^{th} order recursive filter is simply formed by cascading second order recursive filters. Therefore it is more suitable for the VLSI implementation.

We first introduce an $L \times M$ systolic ring structure for the linear convolution equation $Z_i = \sum_{j=0}^{M} w_j x_{i-j}$. We show that the most efficient 1D systolic array for solving linear convolution problems is just a special case of our systolic ring structure with $L = 1$. Next we modify the recursive convolution equation $y_i = \sum_{j=1}^{2} r_j y_{i-j}$ and construct a 2D structure for solving this problem; then we combine these two problems together to obtain our desired systolic architecture. After analyzing the modified algorithm, we see that, in some cases, the algorithm is sensitive to the effect of finite wordlenghth. We then derive a new algorithm which is insensitive to this source of error. The structure based on this new algorithm is similar to the old one, but its implementation takes more space. Finally we comment on the number of multiplications per output in our implementation and in the implementation of the block–state–variable form.

Comments

Only the Abstract is given here. The full paper appeared as [1].

References

[1] B. B. Zhou and R. P. Brent, "A high throughput systolic implementation of the second order recursive filter", *Proceedings IEEE 1988 Conference on Acoustics, Speech and Signal Processing* (New York, April 1988). Also appeared as Report TR-CS-88-04, Computer Sciences Laboratory, ANU, February 1988, 14 pp. rpb103.

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