

IIT Research Scholarship

Final Report

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Introduction

The past year has been transformative experience. I have learned much about the research process, new technologies, and design. Along the way, I shared my findings by publishing two conference papers.

Major Accomplishments

I contributed new designs in the field of hardware decimal arithmetic that excels in both area consumption and speed with respect to previous designs. The overall theme to my research is the use of the signed-digit number system, a well-known technique to postpone a costly arithmetic step when adding numbers. Recently, there has been a resurgence in papers treating decimal arithmetic because incorporating decimal arithmetics units in hardware is very practical for some applications. For example, IBM's Power6 microprocessor includes a decimal floating point unit and is great for businesses that must perform decimal operations to maintain accuracy and follow legal regulations concerning financial calculations.

I have presented my design for a two-operand signed-digit decimal adder/subtractor at ECE day and at the EIT conference in Windsor, Canada. At EIT, my paper was awarded 1st place in the best paper competition. The results of my work show a 25% improvement in speed against previous designs. A second paper was accepted to the MWSCAS conference held in Cancun, Mexico. Via poster presentation, I discussed how signed-digit decimal theory can be extended for multi-operand addition and proposed a hardware solution based on my first work. The results clearly show that my scheme excels for multiple operands; 22% improvement in area-delay for 16 operands.

During these conference submissions, I have been working on a journal paper that is more cumulative and detailed than the individual conference papers. This should be submitted shortly as my advisor and I have already incorporated our final changes. Next year, I hope to be able to find my work in Transactions on VLSI.

Other Accomplishments

During this research experience, I was exposed to many new tools and technologies related to FPGAs. I feel this knowledge is very valuable because FPGAs have become very powerful and versatile making them an ideal component in many designs and prototypes.

I have also written a lot of code to help automate some of my work. I think some of these programs can be very useful to other computer engineers, and I hope to upload them on Sourceforge

or some other code sharing forum. I have yet to document and polish the code though.

Current Work

There are several high-priority task to accomplish within the next three months. First and foremost is to apply to several scholarship/fellowship programs for masters and PhD funding. I have already started writing essays and updating my portfolio. The deadline for NSF is in November, and several others are in December and January.

Second, I plan on submitting a paper to the prestigious ISCAS conference, which will be held in Paris, France. The deadline for papers is October 9, and currently I am unsure what the topic should be. My advisor and I are exploring ideas which incorporate my signed-digit work. One viable option is a decimal multiplier or divider. Another is to evaluate the use of a hybrid SD system in addition circuits. Whatever the topic, a lot of work will have to be done in a short period of time.

The least prioritized item is my work on a blind signal separation algorithm known as FastICA. This algorithm uses statistical independence to distinguish original signal sources within several mixed recordings. It is commonly used in EEG signal analysis because there are many electrodes picking up and mixing brainwaves together. By using Nvidia's CUDA, which is a language for programming graphics cards, I hope to appreciably accelerate this algorithm. I currently have the algorithm ported into C and have just began writing code that utilizes the power of the graphics card.

Conclusions

The past year has been an invaluable experience for me. I have learned many technical and practical lessons and was able to share my findings with the scientific community. Looking ahead, I feel prepared for the research-oriented path that my experience led me to discover.

Thank-you