TEXAS A&M UNIVERSITY
Department of Electrical & Computer Engineering

TRANSFORMING ENGINEERING EDUCATION

ENERGY & POWER SEMINAR

A Parallel Approach for Solving Network Equations in EMT simulation Based on Branch Partition

Abstract

In the field of Electromagnetic transient (EMT) simulation and transient stability analysis, solving the network equations constitutes a significant portion of the computational workload. Traditional approaches usually utilize LU decomposition to solve the linear system derived from the network. But this approach suffers from inherent sequential nature, making parallelization challenging. An alternative approach is to utilize matrix multiplication, which can be parallelized easily. However, matrix multiplication is computationally expensive especially for large-scale systems since it has quadratic computational complexity.

I will first recap the formulation of the EMT simulation problem of the power system network, followed by reviewing some of the existing efforts to parallelize the simulation. Then I will introduce an efficient solver that leverages both coarse-grained and fine-grained parallelism to address these challenges. The proposed approach achieves coarse-grained parallelism by partitioning the network into branches connected by cut nodes. Additionally, it employs a parallel forward/backward substitution algorithm based on recursive node reordering to achieve fine-grained parallelism. Experiment on the IEEE 69-bus system shows our approach is 2.7 times faster than sparse LU and 42% faster than parallel BBDF method with LU solver. Moreover, on a synthetic large-scale system, our method is 14 times faster than single-thread sparse LU and up to 75% faster than parallel BBDF method with LU solver. These findings highlight the efficiency and scalability of the proposed approach.

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11:30 am - 12:20 pm
244 ZACH

Biography

Zhenrui Wang is a PhD student in the Department of Computer Science and Engineering at Texas A&M University. He is a graduate student researcher at the Computer Engineering and System Group under the supervision of Dr. Jiang Hu, co-advised by Dr. Weiping Shi. His current research project utilizes parallel computing techniques to speed up the electromagnetic simulation of large-scale power system networks. He completed his bachelor's degree in electrical and electronics engineering at Huazhong University of Science and Technology in China. After graduation, he continued his graduate studies in the same university and completed his master's degree in control science and engineering in 2020. Prior to joining the PhD program at TAMU, he was a research assistant in the Department of Artificial Intelligence and Automation at Huazhong University of Science and Technology, where he developed object recognition and tracking algorithms that can be applied to many practical applications such as autonomous driving. His master's thesis focused on image-to-image translation techniques aiming to narrow the gap between different image domains.

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