

UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

A GPU-Based Framework for Parallel Spatial Indexing and Query Processing

by

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For the Ph.D. degree in Computer Science and Engineering

Support for efficient spatial data storage and retrieval have become a vital component in almost all spatial database systems. Previous work has shown the importance of using spatial indexing and parallel computing to speed up such tasks. While GPUs have become a mainstream platform for high-throughput data processing in recent years, exploiting the massively parallel processing power of GPUs is non-trivial. Current approaches that parallelize one query at a time have low work efficiency and cannot make good use of GPU resources. On the other hand, many spatial database applications are busy systems in which a large number of queries arrive simultaneously. In this research, we present a comprehensive framework named G-PICS for parallel processing of a large number of spatial queries on GPUs. G-PICS encapsulates efficient parallel algorithms for constructing a variety of spatial trees with different space partitioning methods. G-PICS also provides highly optimized programs for processing major spatial query types. In addition, G-PICS implements efficient parallel algorithms for bulk updates of data. Furthermore, GPICS is designed to work in Multi-GPU environments to support datasets beyond the size of a single GPU's global memory.

Examining Committee

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Publications

- 1) **Zhila-Nouri Lewis** and Yi-Cheng Tu, "G-PICS: A Framework for GPU-Based Spatial Indexing and Query Processing," Submitted to IEEE Transactions on Knowledge and Data Engineering (2019).
- 2) **Zhila Nouri** and Yi-Cheng Tu, "GPU-Based Parallel Indexing for Concurrent Spatial Query Processing," In Proceedings of 30th International Conference on Scientific and Statistical Database Management, July 2018.
- 3) Napath Pitaksirianan, **Zhila-Nouri Lewis**, Yi-Cheng Tu, "Algorithms and framework for computing 2-body statistics on GPUs," Distributed and Parallel Databases, Springer (2018).
- 4) Napath Pitaksirianan, **Zhila Nouri**, Yi-Cheng Tu, "Efficient 2-body Statistics Computation on GPUs: Parallelization & Beyond," 45th International Conference on Parallel Processing, August 2016.
- 5) GPU-Based Parallel Indexing for Concurrent Spatial Query Processing, Yi-Cheng Tu and **Zhila-Nouri Lewis**, US Patent Application No. 62/726,557

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