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标题：**A hybrid parallel cellular automata model for urban growth simulation over GPU/CPU heterogeneous architectures**

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摘要：As an important spatiotemporal simulation approach and an effective tool for developing and examining spatial optimization strategies (e.g., land allocation and planning), geospatial cellular automata (CA) models often require multiple data layers and consist of complicated algorithms in order to deal with the complex dynamic processes of interest and the intricate relationships and interactions between the processes and their driving factors. Also, massive amount of data may be used in CA simulations as high-resolution geospatial and non-spatial data are widely available. Thus, geospatial CA models can be both computationally intensive and data intensive, demanding extensive length of computing time and vast memory space. Based on a hybrid parallelism that combines processes with discrete memory and threads with global memory, we developed a parallel geospatial CA model for urban growth simulation over the heterogeneous computer architecture composed of multiple central processing units (CPUs) and graphics processing units (GPUs). Experiments with the datasets of California showed that the overall computing time for a 50-year simulation dropped from 13,647 seconds on a single CPU to 32 seconds using 64 GPU/CPU nodes. We conclude that the hybrid parallelism of geospatial CA over the emerging heterogeneous computer architectures provides scalable solutions to enabling complex simulations and optimizations with massive amount of data that were previously infeasible, some- times impossible, using individual computing approaches.

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