BLUE WATERS
SUSTAINED PETASCALE COMPUTING

Allocation: Illinois/400 Knh

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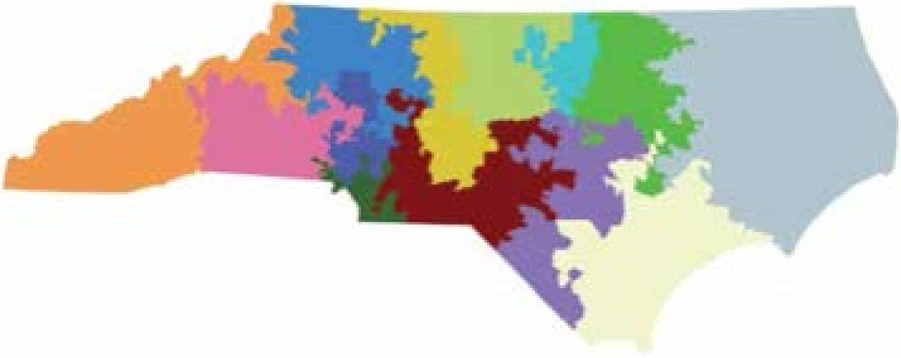

An example of a Congressional electoral map generated by PEAR for the state of North Carolina.

ENABLING REDISTRICTING REFORM: A COMPUTATIONAL STUDY OF ZONING OPTIMIZATION

Research Challenge

Political redistricting is intended to provide fair representation in Congress to all communities and interest groups. Gerrymandering occurs when districts are drawn in a manner that discriminates against a partisan or racial group. Due to a lack of sufficient tools to analyze and synthesize redistricting data, the Supreme Court has found it difficult to identify a workable standard by which we might regulate gerrymandering. This team has developed a computational redistricting tool utilizing massively parallel high-performance computing for redistricting optimization and analysis.

Methods & Codes

The algorithm, PEAR, or Parallel Evolutionary Algorithm for Redistricting, uses MPI nonblocking functions for asynchronous migration, and the C SPRNG 2.0 library to provide a unique random number sequence for each MPI process. They designed spatial evolutionary operators that incorporate spatial characteristics to effectively search the solution space. The parallelization of the algorithm maximizes the overlapping of computing and communication at runtime.

Results & Impact

By incorporating spatial evolutionary operators to handle spatial characteristics and the associated computational challenges, and harnessing massive computing power, PEAR provides a powerful and novel computationally scalable redistricting tool. The discrete optimization framework identifies large sets of quality electoral maps. The project has been the subject of numerous amicus briefs and been discussed in oral arguments before the Supreme Court.

Why Blue Waters

The PEAR library is designed for extreme-scale redistricting applications. From the beginning, it was intended to scale to all of the processor cores on Blue Waters through nonblocking MPI communication calls. The computational approach implemented in the solution requires generating a very large number of electoral maps for quantitative study of redistricting phenomena. Identifying quality electoral maps requires significant computing in the combinatorial optimization process. Generating a large number of statistically independent maps is only feasible on a supercomputer at the scale of Blue Waters.