AMAZING TRANSPARENCY.

University of Illinois at Urbana-Champaign researchers Wendy K. Tam Cho and Yan Liu are restoring fairness to electoral district boundaries.

Redistricting — the process by which congressional and state legislative district boundaries are drawn — sounds like an unremarkable government chore. And, in theory, it should be.

The intent of redistricting is to ensure parity in representation. But in reality, the process is fraught with controversy.

In about two-thirds of U.S. states, the majority political party of the state legislature draws the district lines. Placing self-interested actors at the helm of this process often gives rise to claims of partisan gerrymandering — the manipulating of lines to favor one political group over another. It's a major reason why the re-election rate for incumbents has often been in the mid-90 percent range for the last 40 years.

Though redistricting is widely controversial, the courts have struggled to address gerrymandering because it's difficult to prove.

For political science professor Wendy K. Tam Cho, redistricting embodies an alluring research challenge and a fascinating study of power. "In a human society, how do we decide to structure our governing institutions? How do we decide what's a legitimate form of power?" she says. "I love these kinds of questions. And redistricting is central to power structures in the U.S."

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Long interested in redistricting, Cho developed an idea decades ago for a computational tool that would give the courts a means for objectively measuring the fairness of a legislative map. The tool would generate hundreds of millions of voter district maps that would serve as a "comparison set" — a way to measure the level of partisanship exhibited by any particular electoral map.

But generating these maps represented an immense computational problem — and the computing capacity simply wasn't available yet.

When the Cray "Blue Waters" supercomputer at the National Center for Supercomputing Applications (NCSA) at the University of Illinois Urbana-Champaign came online, Cho says she remembers thinking, "Maybe the computational power exists now to make this idea work." With Blue Waters and her research partner Yan Liu, Cho is bringing her idea to life.

"We've created a tool that quantifies, synthesizes and analyzes massive amounts of redistricting data, both to engage a broader array of interested stakeholders as well as to provide a tool for judges to use in adjudicating gerrymandering claims," Cho says. The aim isn't to end up with one perfectly objective legislative map. Instead, it's to bring transparency to the redistricting process that can come only from generating and scrutinizing billions upon billions of legally viable electoral districts.

"For gerrymandering cases, this provides a method for ascertaining the motives that led to the disputed map. When you use a computer it's not hard at all to tell if the motive was partisan," she says. "The algorithm is clear. After you generate billions of these maps, you can start to understand how different motives lead to maps with different characteristics."

Cho and Liu's algorithm is by far the most computationally efficient to date. It easily produces billions of maps. Previously, others attempting similar analyses topped out at about 10,000.

The next redistricting is in 2020, giving Cho and Liu four more years to keep refining their algorithm. They hope their project will not only enable us to improve our democratic society, but also help spur creative ideas for social scientific progress and societal advances to march alongside technological growth.

NATIONAL CENTER FOR SUPERCOMPUTING APPLICATIONS (NCSA)/BLUE WATERS

The Blue Waters supercomputer, housed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign, is the fastest university system in the world. It's used for a wide range of research problems, from predicting the behavior of complex biological systems to simulating the evolution of the cosmos.

SYSTEM DETAILS

- Cray® XE™ /XK™ hybrid supercomputer
- 288 cabinets
- 13 PF peak performance
- 1.6 PB system memory
- 22,640 XE compute nodes
- 4,228 XK GPU accelerator