

Refined Absorption and Design Theory

Michelle Delcourt

Toronto Metropolitan University

The study of combinatorial designs has a rich history spanning nearly two centuries. In a recent breakthrough, the notorious Existence Conjecture for Combinatorial Designs dating back to the 1800s was proved in full by Keevash via the method of randomized algebraic constructions. Subsequently Glock, Kühn, Lo, and Osthus provided an alternate purely combinatorial proof of the Existence Conjecture via the method of iterative absorption. We introduce a novel method of "refined absorption" for designs and use it to provide a new alternate proof of the Existence Conjecture. The method can also be applied in a black-box fashion to many other design theory problems, including proving the High Girth Existence Conjecture and finding sufficiently spread distributions on designs.

In Special Session 52 on Extremal and Probabilistic Combinatorics at the Mathematical Congress of the Americas 2025.