

**PhD research topic proposal**  
**BME, Doctoral School of Mathematics and Computer Science**

**Name of supervisor :**

**Pach Péter Pál**

**Degree:**

PhD

**Title of the topic:**

**Applications of the polynomial method**

**Short description:**

The polynomial method has a wide range of applications in combinatorics, just briefly mentioning some of these: For example, the Cauchy-Davenport theorem, the Erdős-Heilbronn conjecture (Hamidoune-da Silva theorem), the Erdős-Ginzburg-Ziv theorem can be proved with the help of it, or as one of the most recent ones we could mention Dvir's proof for the finite field Kakeya-problem.

In 2016 with Croot and Lev we developed a new variant of the polynomial method which enabled us to prove Roth-type theorems in certain finite groups, and till then many other applications have been found. Specially, the method lead to the solution of the cap set problem (Ellenberg-Gijswijt), the Erdős-Szemerédi sunflower conjecture (the currently best bound is due to Naslund and Sawin who used this new method) and a tight bound for Green's arithmetic triangle lemma. The method has applications as well: For example, the applicability of STTP (simultaneous triple product property) in reducing the number of steps in matrix multiplication.

The aim of the research is to find more generalizations and applications of this new and other combinatorial methods, moreover to examine the applications of them.

**Requirements:**

basic knowledge of number theory

**Contact:**

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**Place of work:**

Department of Computer Science and Information Theory

**Statement:** *The conditions of the research above are satisfied, the theme is confirmed by the Head of the Department/Institute*