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*Generation of 7x7 Calcrostic Puzzles and Rational Solution of Highly Underdetermined Polynomial Systems*

This talk is on the generation of new types of mathematical 'calcrostic' puzzles. In these puzzles the task is to determine for each letter the corresponding digit that the letter represents such that a number of conditions arranged in the form of a crossword problem are satisfied. Earlier versions of these puzzles were used in Caribou Mathematics Contests with large Canadian and international participation.

Through our work we are able to generate larger calcrostics, now of size 5x5 and 7x7 instead of 3x3, more complicated ones, now involving rational numbers rather than integers, and puzzles that require many more conditions to be satisfied through extra diagonal relations.

Apart from many new procedures that had to be written for handling these new types of puzzles, the key problem was that much larger systems of under-determined polynomial equations needed to be solved with computer algebra. We developed a method of computing special solutions of highly under-determined and highly non-linear, polynomial equations. The new technique was implemented and merged into the computer algebra package CRACK. It was successfully used for the generation of all types of new calcrostic puzzles.