

The talk will consist of two separate parts.

Title: *The stubborn problem is stubborn no more*

Abstract: We present a polynomial time algorithm for the 3-Compatible Colouring problem, where we are given a complete graph with each edge assigned one of 3 possible colours and we want to assign one of those 3 colours to each vertex in such a way that no edge has the same colour as both of its endpoints. Consequently we complete the proof of a dichotomy for the k-Compatible Colouring problem. The tractability of the 3-Compatible colouring problem has been open for several years and the best known algorithm prior to this paper is due to Feder et al. [SODA'05] - a quasipolynomial algorithm with an $n^{O(\log n / \log \log n)}$ time complexity.

Furthermore our result implies a polynomial algorithm for the Stubborn problem which enables us to finish the classification of all List Matrix Partition variants for matrices of size at most four over subsets of $\{0, 1\}$ started by Cameron et al. [SODA'04].

Title: *Cut&Count technique for connectivity problems parameterized by treewidth*

Abstract: The notion of treewidth, introduced in 1984 by Robertson and Seymour, has in many cases proved to be a good measure of the intrinsic difficulty of various NP-hard problems on graphs, and a useful tool for attacking those problems. Many of them can be efficiently solved through dynamic programming if we assume the input graph to have bounded treewidth.

For several problems with global connectivity requirement the best known algorithms were of $t^{O(t)}n^{O(1)}$ time complexity, where t is the width of the given tree decomposition. We present a technique dubbed Cut&Count that allows us to produce $c^t n^{O(1)}$ Monte Carlo algorithms for most connectivity-type problems, including Hamiltonian Path, Feedback Vertex Set and Connected Dominating Set. The constant c we obtain is in all cases small (at most 4 for undirected problems and at most 6 for directed ones), and in several cases we are able to show that improving those constants would cause the Strong Exponential Time Hypothesis to fail.

Our results have numerous consequences in various fields, like FPT algorithms, exact and approximate algorithms on planar and H-minor-free graphs and algorithms on graphs of bounded degree. In all these fields we are able to improve the best-known results for some problems.