Ported or Relative Oriented Matroids and Electric Circuits

Seth Chaiken, CS Dept., University at Albany

The idea of holding back from deletion/contraction of every element in a distinguished set during a Tutte function decomposition has a long history of multiple origins and applications. What we call a "ported" Tutte decomposition or matroid has also been termed "pointed" (for a single distinguished element), "set-pointed", and "relative"; it occurs in the representation of "a matroid perspective." It is now known that the entire elementary theory (activities, rank-nullity generating functions, etc) of Tutte decomposition, even when the element decomposition operations are individually parametrized or "colored", goes through into the ported generalization.

We have observed that the analogous generalizations apply to *oriented* matroids. Ported parametrized oriented graphic matroids are essential for our motivating application: Electrical networks analyzed with combinatorial methods stemming from their solution by tree enumeration due to Kirchhoff and Maxwell, commonly formulated with the Matrix Tree Theorem. Ports enable us to pose the relevent generalizations. The talk will briefly survey our results such as an exterior algebraic Tutte function to generalize tree count and how to derive a family of Rayleigh-like inequalities.

Keywords: relative, ported, set-pointed, oriented matroid, matroid perspective, parametrized, colored, Tutte polynomial, exterior algebra, Rayleigh inequality, electrical network, matrix tree theorem