

Vector Flows in Graphs and Integer Flows in Signed Graphs

Jian Cheng

Department of Mathematics
West Virginia University

Abstract

My research focuses on the flow problems consisting of two parts, *vector flows* in graphs and *integer flows* in signed graphs. The concept of integer flows was first introduced by Tutte (1949) as a refinement of map coloring. In fact, integer flows is the dual concept of map coloring for planar graphs. This is often referred as *duality theorem*. Tutte proposed three celebrated flow conjectures which are arguably the most significant problems in the whole of graph theory. Integer flows is highly related to the graph embeddings and cycle covers. This motivates us to consider flow problems in terms of topology and geometry. Note that Tutte's duality theorem is not true for all embedded graphs. Jaeger (1984) showed that it holds for graphs which can be 2-cell-embedded on some *orientable* surface. If the surface is *unorientable*, then this coloring corresponds to a nowhere-zero flow in signed graphs.

In the first part, I will introduce vector flows and give our preliminary results. Next I will talk about integer flows in signed graphs, present some progress over the last three decades and further propose our problems.