

**Abstract**

**On imbalances in bipartite multidigraphs**

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A bipartite  $r$ -digraph ( $r \geq 1$ ) is an orientation of a bipartite multigraph that is without loops and contains at most  $r$  edges between any pair of vertices with one vertex from each part. For any vertex  $x$  in a bipartite  $r$ -digraph  $D(U, V)$ , let  $d_x^+$  and  $d_x^-$  denote the outdegree and indegree respectively of  $x$ . Define  $a_{u_i} = d_{u_i}^+ - d_{u_i}^-$  and  $b_{v_j} = d_{v_j}^+ - d_{v_j}^-$  as the imbalances of the vertices  $u_i$  in  $U$  and  $v_j$  in  $V$  respectively. We characterize imbalances of bipartite  $r$ -digraphs and obtain recursive, constructive and existence criteria for a pair of sequences of integers to be the imbalances of some bipartite  $r$ -digraph. The recursive criterion provides an algorithm for determining whether the two sequences of integers in non-decreasing order are the imbalance sequences, and for constructing a corresponding bipartite  $r$ -digraph. Finally, we give the existence of a bipartite  $r$ -digraph with a given imbalance set