Resonance graphs of plane bipartite graphs as daisy cubes

Simon Brezovnik, Zhongyuan Che*, Niko Tratnik, Petra Žigert Pleteršek,
Penn State University, Beaver Campus

Daisy cubes introduced by Klavžar and Mollard in 2019 are a subfamily of partial cubes which contains Fibonacci cubes and Lucas cubes. A *daisy cube* generated by $X \subseteq \mathcal{B}^n$ is an induced subgraph of a hypercube Q_n and defined as $Q_n[X] = \langle \{u \in \mathcal{B}^n \mid u \leq x \text{ for some } x \in X\} \rangle$. The concept of resonance graphs was first introduced by chemists motivated from studying the resonance energy of benzenoids. The resonance graph of a plane bipartite graph G is a graph whose vertex set is the set of all perfect matchings of G and two perfect matchings are adjacent if their symmetric difference forms a periphery of a finite face of G. Žigert Pleteršek showed that the resonance graph of a kinky benzenoid graph is a daisy cube. In this talk, we will first provide a structural characterization of a plane elementary bipartite graph whose resonance graph is a daisy cube. Then we will show that a Cartesian product graph is a daisy cube if and only if each of its nontrivial factors is a daisy cube. Applying this property of daisy cubes, we can obtain a structural characterization of any plane bipartite graph whose resonance graph is a daisy cube. Our results generalize recent work on catacondensed even ring systems and 2-connected outerplane bipartite graphs whose resonance graphs are daisy cubes.

Keywords: daisy cube, plane (elementary) bipartite graph, resonance graph