Generalized binomial edge ideals of whisker graphs via an extension of generalized corona products

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Abstract: In this paper, we initiate a systematic study of generalized binomial edge ideals of whisker graphs by working within a substantially broader class of graphs. We extend the notion of generalized corona products, and through this enlarged framework, investigate fundamental algebraic invariants such as depth, (Castelnuovo–Mumford) regularity, and the Cohen–Macaulay property. In particular, we establish a sharp lower bound on the depth of generalized binomial edge ideals for our extended class, and further obtain an explicit depth formula for a broad subclass of this family, which in turn recovers the depth formula for whisker graphs. We also establish sharp upper bounds for the regularity, and in the case of binomial edge ideals of whisker graphs over gap-free graphs, determine the exact value of the regularity. Finally, for our extended class, we provide a combinatorial classification of all Cohen–Macaulay binomial edge ideals, which in turn yields a new construction of Cohen–Macaulay binomial edge ideals.

Keywords: generalized binomial edge ideals, whisker graphs, depth, regularity.