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## Modeling Uncertainty with Bipolar Picture Fuzzy Graphs

### Communication Info

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### Abstract

Graph theory has long served as a fundamental tool for modeling complex systems, beginning with Euler's solution to the Königsberg Bridge problem and later expanded through Kirchoff's work on trees. As classical set theory cannot adequately represent uncertainty, Zadeh introduced fuzzy sets [1], followed by Atanassov's intuitionistic fuzzy sets [2], enabling richer forms of approximate reasoning. Rosenfeld's fuzzy graphs [3] further extended these ideas to relational structures, inspiring additional developments in fuzzy and bipolar fuzzy graphs. More recent contributions include picture fuzzy graphs [4] and bipolar picture fuzzy graphs (BPFGs) [5], which allow simultaneous modeling of positive and negative information.

We introduce a generalized BPFG model, define six membership functions, and examine two key operations: rejection and symmetric difference. The results demonstrate that BPFGs provide an effective framework for representing complex and uncertain relationships within graph-based systems.

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