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Detecting and refining overlapping regions in complex networks with three-way decisions

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**Highlights**

- The three-way representation of communities as a triple of positive, boundary and negative regions brings more insight into interpretation of communities.
- The overlapping regions are further refined into 4 macro types and 8 micro types.
- The three-way decision strategies are introduced to detect the overlapping communities based on the introduced relation-graph.
- A new fitness function is devised to adapt to processing networks with overlapping.
- The refinement of overlapping regions can reveal the different significance to impact forming or changing of communities.
- The proposed method is efficient and highly appropriate for detecting overlapping communities.

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