**Exact and Approximate Algorithms for Finding k-Shortest Paths with Limited Overlap**

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**MOTIVATION**

Finding multiple short yet different routes between two locations in a road network is a problem with various real-world applications:
- Commercial Route Planners
- Evacuation planning
- Humanitarian aid

**k-SPwLO PROBLEM**

Given a source \(s\) and a target \(t\), the **k-SPwLO** is a set of \(k\) paths from \(s\) to \(t\), sorted by length in increasing order, such that:

(a) the set includes the shortest path \(p_0(s,t)\),
(b) every path is dissimilar to its predecessors w.r.t. a similarity threshold \(\theta\),
(c) all \(k\) paths are as short as possible.

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**EXACT ALGORITHM**

- **MultiPass**
  - Traverses the road network \(k-1\) times
  - Restarts the expansion after each alternative path is found
  - Employs two powerful pruning criteria

**APPROXIMATE ALGORITHMS**

- **OnePass**
  - Traverses the road network once
  - Prunes paths with both PC1 and PC2
  - Does not guarantee that the exact solution will be found

- **ESX (Edge Subset Exclusion)**
  - Iteratively removes edges from the road network that lie on some already computed alternative path
  - Computes the shortest path on the updated graph
  - Continues until a sufficiently dissimilar path is found

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**EXPERIMENTAL EVALUATION**

- **MultiPass**
  - Computes the optimal result but is practical only for small road networks

- **OnePass**
  - Good approximation and practical for larger road networks than MultiPass

- **ESX**
  - Less accurate but practical even for large road networks and large values of \(k\)

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**SUMMARY**

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