Non-Separable Multi-Dimensional Network Flows for Visual Computing

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METHODOLOGY

Non-Separable Multi-Dimensional Network Flow
We define our approach as a mixed-integer program with a binary variable and two special constraints:

• Node count: A single incoming and a single outgoing flow vector may have non-zero flow. → Flow vectors can not be separated through nodes.

• Total count: We fix the number of flow entities leaving the source node and entering the target node to a specific value.

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Variables

- V: nodes with a source node s ∈ V and a sink node t ∈ V
- E ⊆ V × V: set of (directed) edges
- c ∈ Rk+1: capacity vector with k commodities
- \( \sum_{b \in E} c_{b} = d - \sum_{s \in E} \sum_{t \in E} c_{s,t} \) (total count).
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- n: number of flow entities

Application to Multi-Object Tracking
We define three different types of edges: observation edges (between objects), transition edges (between frames), and enter/exit edges (source/sink connection).

The objects of the three sample frames are represented by feature vectors.

These vectors are set as capacity on the corresponding object edges. All other edges have infinite capacity.

RESULTS

Experimental Setup
Features from bounding boxes are reduced and set as edge capacity in graph to extract object tracks.

Robustness Evaluation
To evaluate the robustness, we add random Gaussian noise with different variances to every image.

Quantitative Results
Our method performs better on noisy images than the scalar method with different feature descriptors.

Qualitative Example (Seq 11)
The scalar method has an identity switch, our method has no identity switch (red arrow).

REFERENCE