The Gixel Array Descriptor (GAD) for Multi-Modal Image Matching

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Multi-Modal Image Matching
Multi-modal images usually exhibit different patterns of gradient and intensity information.

Additive Edge Scoring

Line Features
- We observe that line features are the most important and reliable features in multi-modal matching applications.
- In multi-modal data, line features may appear with gaps or zig-zag segments.
- The “Gixel” samples the information of a long connected line similarly to a series of short dashed line segments.

The Scoring
- For each line, three elements of information are encoded: orientation, length, and distance to the Gixel.
- Score increases with length and decreases with distance.
  \[ \text{Score}(l, d) = f(d) - f(d + l) \]
- Manhattan distance is used instead of Euclidean distance, to achieve the additive property.

The Gixel Array Descriptor (GAD)

The “Gixel”
- Abbreviated from “Gradient Pixel”, a Gixel is a sample point for the gradient information in a small local region.
- It serves as a basic unit of the complete GAD descriptor.
- Each Gixel is used to sample and score gradients in its neighborhood.

The Array
- The Gixel Array Descriptor consists of several Gixels in a circular array.
- Scores of all Gixels are normalized to represent relative gradient distribution between Gixel regions.
- Three parameters are involved: the number of circles, the number of Gixels on each circle, and the distance between each circle.

Rotation and Scale Invariance
Search for scale and rotation changes. The Gixel sample point array positions are adjusted for each search step.

Experimental Results Comparison

- Scores of all Gixels are normalized to represent relative gradient distribution between Gixel regions.
- Three parameters are involved: the number of circles, the number of Gixels on each circle, and the distance between each circle.