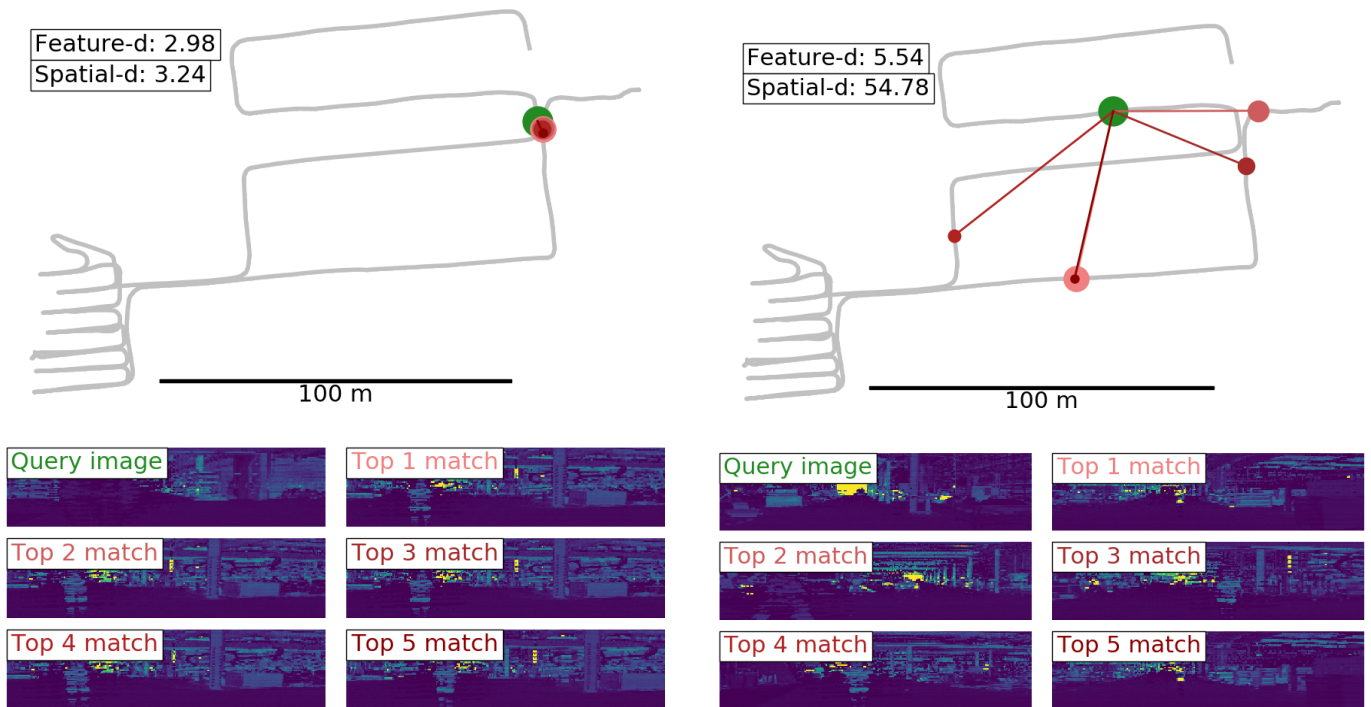# Loop-closure detection by LiDAR scan re-identification

A paper by Jukka Peltomäki, Xingyang Ni, Jussi Puura, Joni-Kristian Kämäräinen, Heikki Huttunen

Feature-d: 2.98
Spatial-d: 3.24

100 m

Feature-d: 5.54
Spatial-d: 54.78

100 m

Query image | Top 1 match
Top 2 match | Top 3 match
Top 4 match | Top 5 match

Query image | Top 1 match
Top 2 match | Top 3 match
Top 4 match | Top 5 match

A deep neural network is trained for visual search with physical distance as the ground truth. This creates a feature space embedding such that images can be compared with each other to detect loops completely in feature space only. The graph below shows that euclidean distances in feature space are usable for detecting loop points. The pictures above illustrate the method, as in the loop point the top 5 feature space matches are close by, and in a non-loop point the matches are further away. (The points right before and after the query point are discarded, as they would be useless when detectin loops and too easy a case for the network.)

An example of a 360 degree LiDAR intensity image is shown below. 2048 x 64 pixels with an 8 bit grey scale intensity. (The example here is colored.)

We employ a panoramic rotation augmentation in our experiments, which is done by rolling the 2D input image.

Green marks the tested loop point zone.

Euclidean distance

Nth query point

Top 1 match distance
Moving average (60 matches)

0° 90° 180°

180° 270° 360°