This work is focused on the exploration of an unknown environment by a team of mobile robots. Each robot in the team discovers its neighborhood and contributes to a global map. The aim is to explore the environment with minimal effort (e.g. time, distance traveled, fuel consumed, etc.)

**Used tools and algorithms**
- Robot Operating System (ROS)
- Clipper - clipping library
- Triangle - triangular mesh
- Visibility graph
- Dijkstra’s algorithm
- K-means clustering

**Exploration**

The mobile robot exploration is the process in which robots autonomously operate in an unknown environment. The robots are navigated through the environment in order to create a map of it. The map is incrementally built and serves as a model of the environment for further exploration steps. The process consists of a goal selection and navigation towards the selected goals. This is repeated until unexplored areas in the map exist.

- Comparison of polygonal approach against the commonly used occupancy grid.
- Polygons have 1226 vertices vs. 12 076 800 cells in the grid.

**Goals**

- Use a polygonal representation instead of an occupancy grid
- Modify clipping library to work both with polygons and their attributes
- Reduce computational complexity to represent large environments
- Handle problems in coordinated multi-robot exploration
- Compare selected exploration algorithms on various maps

**Results**

- A framework has been implemented using ROS in C++ language
- The clipping library was modified
- The polygonal approach proved to be a feasible method for the map representation
- With a quite low number of points it is possible to represent really big environments
- All the parts of exploration were successfully adapted to the polygonal representation which was proved by the experiments
- The results were presented at ICAPS 2013 conference in Rome

**Experiments**

- Comparison of state-of-the-art exploration strategies
- 4,6,8,10 robots
- Exploration strategies: Greedy, Hungarian, BLE, K-means
- 4 testing environments
- Number of experiments: 1440
- Total time of experiments: 240 hours

**K-means exploration strategy**

<table>
<thead>
<tr>
<th>Polygons</th>
<th>Occupancy grid</th>
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</thead>
<tbody>
<tr>
<td>L_{plan} [m]</td>
<td>L_{total} [m]</td>
</tr>
<tr>
<td>m²</td>
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<tr>
<td>13000</td>
<td>36</td>
</tr>
</tbody>
</table>

**Hospital map**

271x110m explored with 10 robots