



SafeLog

Safe human-robot interaction
in logistic applications
for highly flexible warehouses

Planning for complex logistic systems

Miroslav Kulich



Czech Institute of Informatics, Robotics and
Cybernetics, Intelligent and Mobile Robotics



This project is
funded by the
European Union
GA-Nr. 688117

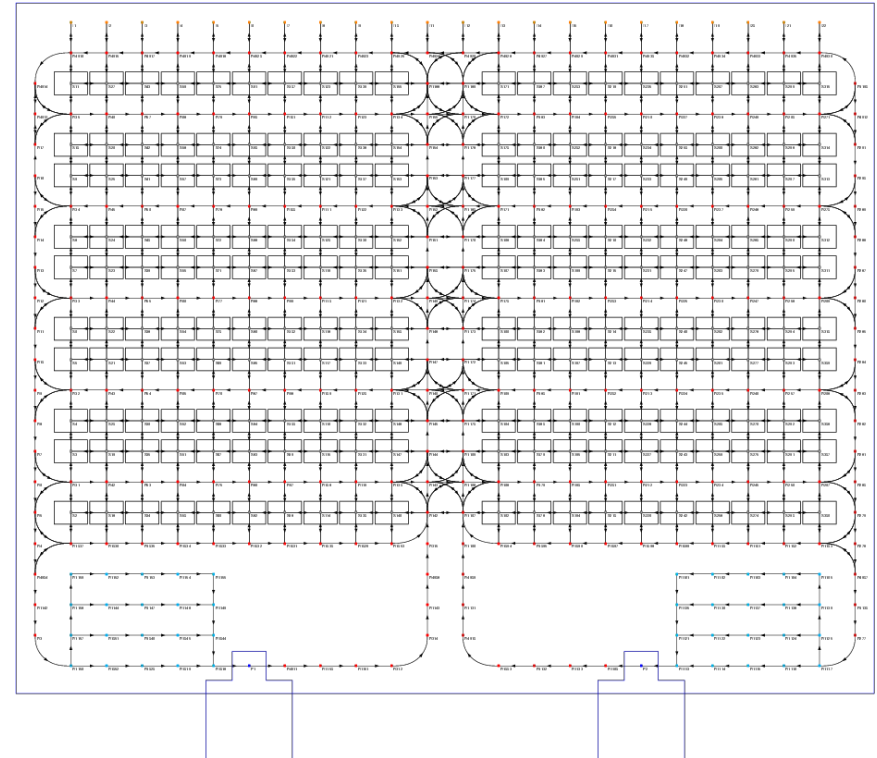
Overall goal

- To realize a planning module that will provide coordinated plans for robots and humans in the warehouse in order to maximize the number of picks per time:
 - ✓ reduce the transport time
 - ✗ reduce average travel distance
 - ✗ increase the number of picks per transport assignment



Requirements

- Collision-free trajectories
 - No deadlocks
 - Heterogeneous robots
 - Minimal waiting times
 - Minimal (no) waiting of a picker
 - Fairness
 - “In operation” charging
 - Low computational complexity
-
- **Minimal setup**
 - 150 AGVs
 - 2000 containers
 - 12 picking stations
 - 6000 assignments/hour



Human-related requirements

- Human as another entity
- “Natural” paths
- Safety levels B+C

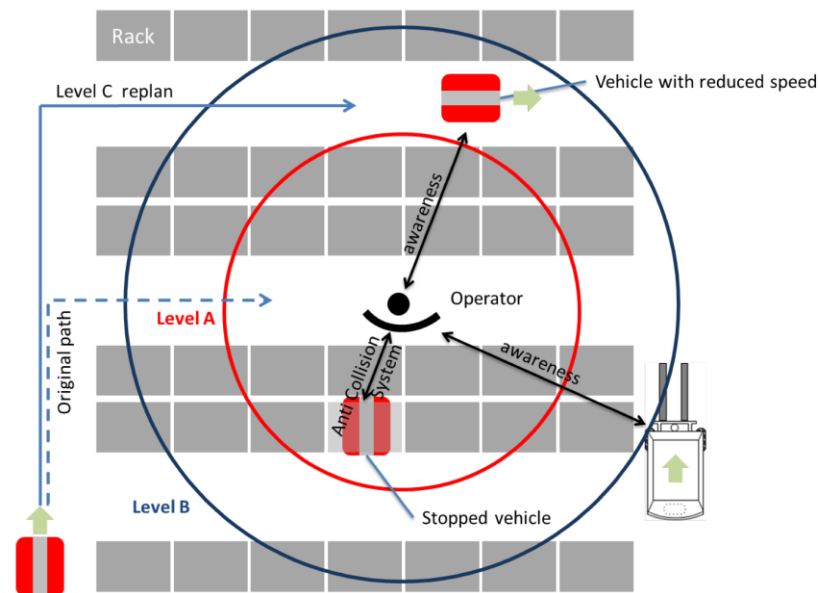


Figure 3: Safety levels of the integrated safety concept

Safety issues

- Risk to hurt persons directly (moving carries, falling goods; as expected)
- Escape way is blocked by two (loaded) carries in an alley
- Access way to person in distress is blocked
- Psychologic stress to a person

