

Robot navigation and map building

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Abstract

Human tries to ensure comfort for himself from the beginning of times. Scientific and technological advance, serving this need, produced the 'physical body' and the 'power' during the industrial revolution, while information revolution is at the doorstep of creating the 'spirit', which controls the body autonomously. One of the key tasks of this controlling intelligence is navigation. Navigation may clarify location and relation of objects and living beings, and it aids the recognition of the environment surrounding the acting agent. These are important elements of further tasks solving.

There are two alternative ways to realize efficient navigation. An obvious possibility is the constructive, engineering approach that creates appropriate representations and algorithms from scratch after a deep investigation of the problem. Another attitude reaches its goal through the analysis of successful existing methods. Animals may supply these functioning navigational solutions.

Researchers must be prepared for several difficulties of navigation. Actors placed in real-world environments — in contrast to classical artificial intelligence — do not use preprocessed, abstract senses for decisioning. They rely only on finite-range, noisy, error-prone perceptions and construct the representation of the environment based on low-level signals of sensors. At the same time actions of the agents are inaccurate and faulty. Furthermore, robots have to determine their position related to the perceived environment and the location of neighboring objects related to their stance for navigating appropriately. During navigation environment map has to be formed using the incoming sensor information. This means that former inaccurate measurements are ameliorated, confidence of precise perceptions is raised, new information appears at fresher parts of the map, and former false measurements are removed. An important question is the choice of appropriate representation of the map. The solution has to adapt to several properties of the problem: the specificities of the task at hand, the capability and the modality of sensors, the surroundings of the job, and the computational capacity. After map creation agents must perform motion planning and control to find their way to the goal taking into consideration the character of the terrain and their kinematic motion constraints.

A navigating robot has to provide a universal, autonomous, robust, and real-time solution of all the problems outlined above. This is one of the most important open questions of mobile robotics. In the presentation I investigate aforementioned problems and possible solutions of navigating robots.