Integrating Learning for Robust Development

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We have been working towards a new language for programming robots. This new language looks just like regular C, with two added features: First, it supports probabilistic reasoning. Second, it supports learning. We believe probabilistic reasoning (or more general, reasoning under uncertainty) is essential for robotics, since robot sensors are inherently limited, and in most interesting environments, robots are unable to accurately estimate the state of the world. Probabilistic mechanisms enable robots to reason with uncertainty. A series of recent experiments carried out in our lab (which included the Rhino museum tour-guide) has, as we think, put forward convincing evidence for the utility of probabilistic representations. Learning is equally important. While we instruct humans through various different means (we teach the rules, show them example solutions, provide reinforcement and so on), most existing, successful robots are instructed just through a single mean: conventional programming. We envision that by integrating both programming and learning from examples, we can significantly reduce the costs involved in developing robot software, and get more scalable systems. If this research is successful, then future robots might be "programmed" through a mix of conventional code development (e.g. in C), instruction (human user tells the robot what to do in example situations), demonstration (human user demonstrates an example problem solution to a robot), and autonomous learning (robot find solution by itself). They might represent internal knowledge using probabilistically, and perform more robustly in the face of uncertainty. The new framework also supports concurrency.

This, of course, is only one of the many important new directions in robotics. We happen to believe that indoor navigation is mostly a solved problem, and that among the most promising, open research directions are human-robot interaction, mobile manipulation, and distributed robotics. We would be happy to attend and hear about more promising research directions.