CSP2Turtle: Verified Turtle Robot Plans and Beyond

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Abstract

Software verification is an important approach to establishing the reliability of critical systems. One important area of application is in the field of robotics, as robots take on more tasks in both day-to-day areas and highly specialised domains. Our particular interest is in checking the plans that robots are expected to follow, to detect errors that would lead to unreliable behaviour. Python is a popular programming language in the robotics domain, through the use of the ROS and various other libraries. Python's `Turtle` package provides a mobile agent, which we formally model here using CSP. Our interactive toolchain CSP2Turtle with CSP models and Python components, enables plans for the turtle agent to be verified using the FDR model-checker before being executed in Python. This means that certain classes of errors can be avoided, and provides a starting point for more detailed verification of `Turtle` programs and more complex robotic systems. We illustrate our approach with examples of robot navigation and obstacle avoidance in a 2D grid-world. We evaluate our approach, and discuss future work.