Autonomous System for Mobile Pick-and-Place Task in Unknown Environments

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***Abstract*— We present a fully autonomous and integrated system that solves a critical and challenging problem in service robotics, that of end to end pick-and-place task (with and without task constraints) in unknown static environments. Our system is illustrated on a mobile manipulator equipped with base mounted and eye-in-hand sensors. The system intertwines one-step mobile manipulator planning and base mounted sensor scan with multi-steps manipulator planning interleaved with eye-in-hand sensor based exploration. We believe that our integrated pick-and-place system scores several firsts: a) its competency is far superior to that of the previous integrated planning systems in that it considers the currently unexplored (and unknown) region as obstacle, thereby resulting in completely safe paths, b) it explores the unknown environment as well as unknown grasping object using both base mounted and eye-in-hand sensors, c) it integrates two different view planning schemes to build a global world representation in term of Octomap, and finally d) the underlying planners judiciously generate safer paths for next best view of the base (NBV-B) and the arm (NBV-A) by considering base pose uncertainty and its effects on manipulator motions. We demonstrate our system both in simulation and on the actual SFU mobile manipulator. We also experimented with incorporated task constraints and report on lessons learned on system specifics and practical issues:**

I. Related Work

[1], [2] presents a mobile manipulator planner that decomposes the full C-space into two sub spaces for the base and the arm, such that the planning in arm C-space is invoked on a need to basis. [3], [4] proposes localization based sampling and conncection strategies for sampling based motion planners. [5] extends the earlier work to incorporate uncertainty at different levels. More detail can be found in [6].

References

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