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Moving Walls

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In the early 1980s, I used Stan Rosenschein's functional language REX to servo Flakey's two wheels to set points of speed and direction that were functions of sonar readings. This let Flakey drive along hallways with no dead reckoning or planning whatsoever. It seemed miraculous at the time; a situated automaton that knew things without needing any models. However, I thought of it as (sensor-driven) feedback control, versus (plan driven, eyes shut) feed-forward control.

I then used Mike Georgeff's procedural reasoning system (PRS) to make Flakey not only drive but navigate an office building. In some respects this project succeeded: the robot's "domain knowledge" was nothing more than a static connection graph—no distances to drive, no widths of halls or doorways, no a priori obstacles—such information was acquired en route from sensory input. In other respects, however, progress was unsatisfying. The robot would frequently get stuck facing a wall, interpret it as an obstacle, ask it to move, and then wait forever. The robot was just as helpless as if it had made a dead-reckoning error.

The fault was that the robot expected a doorway where none existed and perceived the wall as a (presumably) movable obstacle on its path. I soon saw that my program worked well only where it employed sensory feedback and that the PRS procedures were another form of feed-forward control, with built-in (though branching) expectations overruling sensing.

This realization led to the conception of *universal plans:* feedback control through Boolean state-spaces, viewing plans as control laws, and planners as reaction-choosers based on a weak model of action effects. From there, what actually happens is up to Nature, and yet "reaction plans" reliably achieve their goals because of their robustness and persistence.

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