New algorithm could improve automated systems

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Video Abstract

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Abstract

Researchers from China have created an algorithm that could make today's automated systems even more powerful. The algorithm is based on a technique called model predictive control. This type of control is what makes many smart guidance systems, well, smart. Consider, for example, a self-guided robot. To be useful, the robot must be able to manage its fuel resources wisely under a slew of conditions that are subject to change, including terrain, wind speed, and distance traveled. Model predictive control tracks all these factors on the fly to ensure the robot travels along the most efficient route. The key to mapping that route is determining what set of actions the robot can carry out to meet all the environmental constraints it faces simultaneously. Mathematically, this small cluster of solutions is what's known as the feasible set of the system—the discovery of which can be treated as a geometry problem. The objective: find the shape that contains the full set of possible solutions. While researchers have developed various ways of zeroing in on the right shape, the task is a tall order for highly complex systems. Carrying out these methods can be rather time-consuming and can even deplete the memory of an onboard computer. Now, there might be a better way. The algorithm devised by the research team from China searches for the corners of a feasible region by scouting the computational space at different angle intervals. By iteration, the program quickly arrives at just the right interval that maps the entire feasible set. Simulations showed that this so-called polyhedral computation approach can be extended to higher-dimensional systems in which numerous environmental factors must be monitored. But only up to a certain point. For extremely complex systems, the computational burden becomes practically impossible to bear. More work is clearly needed, but the potential for application is there. With further improvement, the new approach could provide a much-welcome performance boost to our increasingly automated world.