



# CHALLENGE 44

## CMU-MPN-01

### Constant-Time Motion Planning for Navigation and Flight in Fast-Paced & Cluttered Environments

The Search-Based Planning Lab:

[www.sbpl.net](http://www.sbpl.net)

Meet the expectations of this US Node  
through the technology challenge  
described below



## GOALS

Robots often perform recurring tasks in structured environments. Fast and reliable motion planning is one of the key elements that ensure efficient operations in such environments. This will have impact across a large number of domains - we are exploring the following:

#### Example Scenarios:

**Conveyor Belts:** A very common example scenario is of manipulators working at conveyor belts, where they have limited time to pick moving objects, and if the planner exceeds a certain time threshold, they would fail to pick the objects up.

**Automated Assembly Lines:** Similar scenarios are encountered in automated assembly lines. Such time-critical applications spur the need for planners which are guaranteed to be fast. To this end, we recently introduced the concept of Constant-time Motion Planning (CTMP) - namely, the ability to provably guarantee to generate a motion plan within a (small) constant time - and developed several algorithms that fall into the class of CTMP algorithms. So far, these algorithms were developed for manipulation tasks such as pick and place tasks, working at a conveyor, and mail sorting.

## DETAILS

The main objectives for this challenge are: Extend the Constant-time Motion Planning (CTMP) Framework: We are interested to extend the CTMP framework to support planning for autonomous navigation and flight, in particular, in the context of planning for aggressive maneuvers, such as avoiding possible collisions at high speeds. Develop New Algorithms: The project would entail developing novel CTMP algorithms, proving their theoretical guarantees on bounded planning times and completeness, and evaluating their performance in simulation.

## SKILLS REQUIRED

Experience in robot planning.