ToD & DyP: A planning solution for efficient navigation in changing environments

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Path planning in changing environments is a challenging issue for an autonomous entity considering that accessibility in such environments can change at any time.The novelty of the presented approach is that an autonomous entity is now able to navigate in a environment where moving objects are not only considered as obstacles but are also used to help navigation.

From an entity's point of view, any object present in an environment implies changes by obstructing areas or by allowing access to previously unreachable locations. In the context of interactive applications, virtual entities evolving in changing environments have to be aware of those changes and to take into account topology modifications during their navigation tasks. In this poster, we present a path planning algorithm addressing a novel problem: finding a path in a changing environment by considering every object, static or moving, both as an obstacle and as a useful navigable area which can help the entity in its navigation task.

Our path planning method, ToD & DyP (*Topology Detection and Dynamic Planning*), relies on the characterization of subspaces of the C-space using the entity's space occupation and its navigation capabilities. The characterization is achieved by defining *Interaction Volumes* representing feasible and colliding configurations, in the C-Space, resulting from the interaction of an object and an entity in the workspace. On the basis of this characterization, ToD efficiently detects and tracks relations between objects of the workspace as well as their impacts on the entity's navigation possibilities. It provides an *Interaction Graph* which is a coarse, but anytime, representation of the C-space topology. Finally, DyP uses this information to interconnect roadmaps of distinct objects and provide a global path planning structure. It first selects a set of geometric objects belonging to the global path and then refines this coarse path by computing a local path on each selected object.

Results shows our algorithm is compatible with interactive applications. Moreover, by considering movable objects as obstacles but also as navigable parts of the environment, ToD & DyP allow us to solve new complex problems by using available objects to access previously unreachable locations.

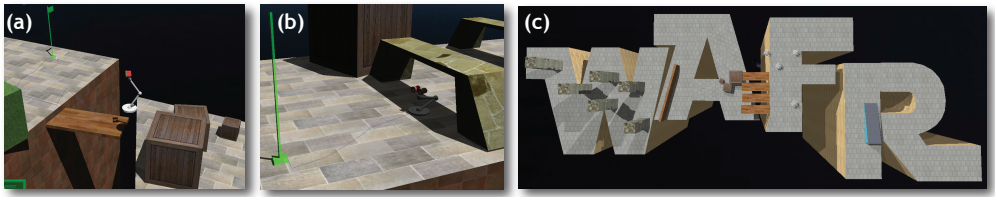

Figure 1: Using our algorithm, the entity (a hopping lamp) can navigate through disconnected surfaces (a), bend down when it cannot stand (b), and find its path through a more complex scene (c).