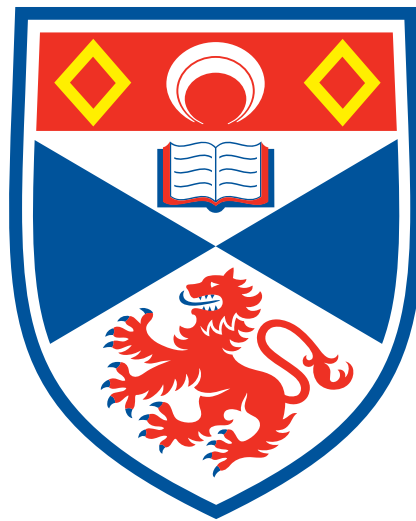

Generating Safe Paths in Dynamic Environments By Actively Predicting the Motion of Obstacles



University of
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CS4099: MAJOR SOFTWARE PROJECT

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Abstract

I declare that the material submitted for assessment is my own work except where credit is explicitly given to others by citation or acknowledgement. This work was performed during the current academic year except where otherwise stated.

The main text of this project report is NNN words long, including project specification and plan.

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Chapter 1

Design

$$\zeta_a(t) = \begin{cases} \zeta_a(t - \delta t) + \zeta'_a(t) \cdot \delta t + \rho & \text{if } t > 0 \\ \zeta_a^{(0)} & \text{if } t = 0 \end{cases} \quad (1.1)$$

Where $\rho \sim \mathcal{U}(-\epsilon, \epsilon)$ and $\epsilon > 0$.

$$P_a^{(t_0, t_m)}(x, y) = \int_{t_0}^{t_m} \mathcal{N}(\zeta_a(t), \alpha \cdot (t - t_0)^2 + \beta, x, y) \cdot (t_m - t)^\gamma dt \quad (1.2)$$

Where $\mathcal{N}(\mu, \sigma^2, x, y)$ is the evaluation of a 3D normal distribution centered at (μ_x, μ_y) with a variance of σ^2 at (x, y) .

$$P_A^{(t_0, t_m)}(x, y) = \frac{\sum_{a \in A} P_a^{(t_0, t_m)}(x, y)}{|A|} \quad (1.3)$$

$$C_A^{(t_0, t_m)}(i, j) = \int_0^1 \exp\left(P_A^{(t_0, t_m)}(x(\lambda), y(\lambda))\right) \cdot \|i - j\| d\lambda \quad (1.4)$$

Where $x(\lambda) = (j_x - i_x) \cdot \lambda + i_x$ and $y(\lambda) = (j_y - i_y) \cdot \lambda + i_y$ are the parametric equations of the line from i to j .

Algorithm 1 ROADMAP(n, d, O)

Input:

n : Maximum number of possible samples

d : Maximum distance between neighbouring nodes

O : Set of obstacles

Output:

An unweighted graph of points describing the connectivity of the environment

```

1: for  $i = 1$  to  $n$  do
2:    $q \leftarrow \text{RANDOMPOINT}(W)$ 
3:   if  $\bigwedge_{o \in O} \neg o.\text{inside}(q)$  then
4:      $V \leftarrow V \cup \{q\}$ 
5:   for all  $q_i \in V$  do
6:     for all  $q_j \in V$  do
7:       if  $q_i \neq q_j \wedge \|q_i - q_j\| \leq d$  then
8:          $E \leftarrow E \cup \{(q_i, q_j)\}$ 
9: return  $(V, E)$ 
```

Chapter 2

Discussion