ETSVL006- 2017- Single-Objective Path Planning for Autonomous Robots Using Reconfigurable Analog VLSI

Abstract

This paper presents path planning using reconfigurable analog very large scale integrated (AVLSI) circuits. Existing research has shown that custom AVLSI circuits known as application specific integrated circuits (ASICs) can theoretically be used for path planning. There are two main drawbacks to using custom ASICs: 1) circuit designs are fixed to some extent (not changeable) and 2) long design cycle/fabrication time (order of months). Reconfigurable analog circuits called field-programmable analog arrays (FPAAs) have been used to implement a variety of AVLSI circuits in a short time (order of minutes). This paper presents an algorithm for mapping a robot's environment onto an FPAA, and then presents hardware results using an FPAA to implement the path-planning algorithm. Experimental results and analysis are presented for 24 environment scenarios. Digital search methods like breadth-first search have solutions which scale on the order of $O(4d)$ whereas this paper will show our analog solution is on the order of $O(d)$ where d is the depth of the solution.