CNC Laser Cutting Machine

Ammar Ahmed, Thomas Bock, Tan Hua and Michael Golez  
*California State University, Sacramento*

EEE-193A/CPE 190  
2-10-2016

# Introduction

In the industry, a widely used component for cutting and engraving materials is a CNC laser cutting machine. The machine operates by using a high-energy infra-red laser light beam. A focusing lens is attached to the laser in order to concentrate the energy into single focal point, thereby vaporizing and melting the material of interest. In order to alter the position of the laser into a desired location, a computer program known as CNC drives the positon of both the x and y axes. Asides the orientation of the axes, CNC codes can adjust the intensity of the laser to optimized the speed of the engraving or cutting of the material. Finally, by using machine vision, through the process of object orientation we can determine the position of the material. This process allows alteration of the material for better result, so that during the process the engraving or cutting is accurately done. The creation of the CNC Laser Machine will be conducted into four different parts: the mechanics between the positions of the CORE x-y axes, the laser machine circuit, CNC software for control and intensity, and finally detection system.

# Construction

* 1. *CORE x-y axes*

The laser tool head will be mounted in movement platform built following the Core X-Y movement theory. Core X-Y is a derivative of the Cartesian movement theory where the axes of movement are rotated 45 degrees from the X and Y axes. This allows for minimizing backlash and maximizing precision while only slightly adding to the complexity of the design.

The motion platform will consist of two stepper motors, several linear rods, linear bearings, belt runs, and pulleys. These will be attached to a main gantry plate, made of aluminum or similar material, which will be CNC machined for precise mounting of all of the components. Our main goal for the size of the gantry would allow the dimensions of the build area to support an A4 sized sheet of paper.

* 1. *Laser Cutter*

Laser Operational Function.

The laser cutter will operate through the combination of a laser diode driver and laser diode. By combining both systems the driver will produce a constant regulated voltage and current that will be driven to the load. By simply altering the value of the PWM the user can modify the voltage and current being outputted towards the diode.

Risk Management

To minimize risks, certain components will be attached to the circuit. A heatsink device will be attached to the laser to regulate the temperature of the driver. Then safety goggles are worn by the user to prevent the laser from impeding their vision. There will be a shroud or enclosure for the laser to minimize risk to bystanders

* 1. *CNC software*

Creating the products from the CNC laser cutting machine is a 3-phase process. Starting from the user’s design on CAD (Computer Aided Design) tools, which define the dimensions and final design of the product before the execution. The next phase is CAM (Computer Aided Manufacturing) process, where the design created from CAD will be translated into the last phase of the process, G-code. G-code is the numerical control programming language to control the laser functions, such as movement, laser information, types of shapes, coordinated system.

* 1. *Detection System*

Computer vision ‘C.V’ system will be used to identify the working space of the machine. A camera will be placed on top and parallel to the working space. The camera will take a picture of the object that will be cut and send the picture to the microcontroller or Raspberry Pi (to be determined). The open CV along with the algorithm (triangle similarity technique) will be used to determine the dimension of the object. Based on the dimension, the microcontroller will be updated so that the cutting process stays within the working space.

# Functional Operation Flowchart

