Control of a Pneumatic Actuator Using Pulse Width Modulation

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Pneumatic actuators are compact, fast, powerful, simple, and inexpensive. They are very good for linear on/off applications but have major limitations with their speed and positional control. They find many uses in manufacturing pressing, sealing and sorting and for robotics grabbing, lifting. If you have seen a powerful battle bot grabbing, flipping, or hitting another robot with a seemingly uncontrolled weapon, it was most likely a pneumatic actuator. The goal of this project was to provide a speed and positional control mechanism that is cost and space efficient, just like the actuators themselves. Prototypes were engineered to provide speed control over a very wide range (200ms-30seconds), and good positional accuracy within 300ms. This was achieved via a novel approach of re-using the exhausted air for control with a valve in the reverse of its normal operation. The valves were controlled using Pulse Width Modulation, where the width of the pulse turning on the valves varied in width while the frequency remained the same in order to control the average air flow. The project included the design of a Printed Circuit Board control shield which plugged on an Arduino microcontroller and connected to the valves. This enables robotics and industrial designers to use pneumatic actuators when they need their tremendous power and speed but still desire full control.