

ABSTRACT

An accelerometer is to be used to track the lateral position of the cane as it's being swept from left to right. An accelerometer evaluation board is subjected to back-and-forth movements to simulate normal sweeping of the cane. Accelerometer analog output signal is analyzed for verification of operation.

THEORY

The acceleration of a guide-cane can be used to track its movement. The sweeping movement of a guide-cane can be represented by a sinusoidal waveform. Its second derivative can represent the cane's acceleration.

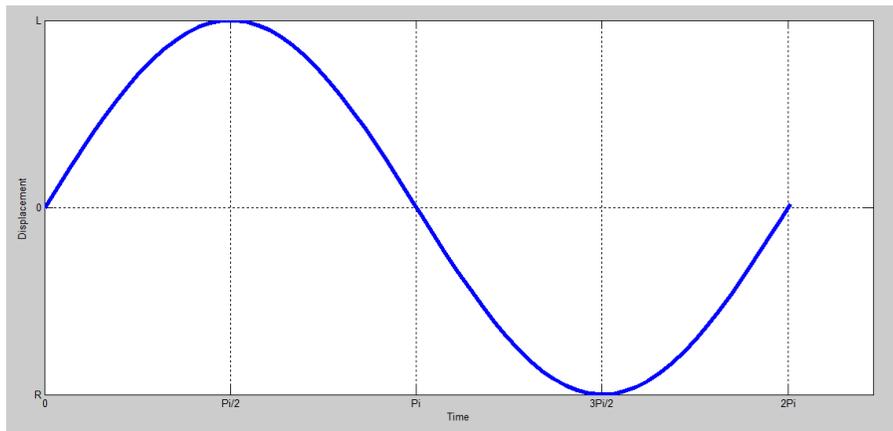


Figure 1. Angular Displacement of Cane over one period

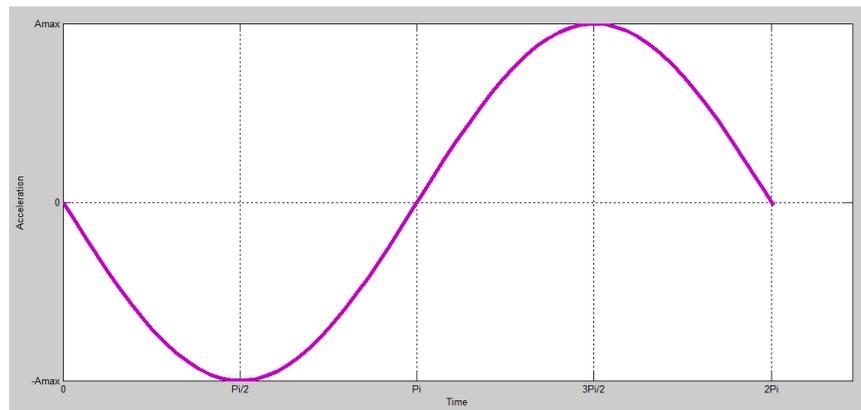


Figure 2. Angular Acceleration of Cane over one period

Thus, the acceleration experienced by the cane will be used to determine whether the cane is pointed to the left or to the right. The accelerometer that's planned to be used for P15043's SmartCane will output an analog voltage, dependent upon the incident acceleration and the accelerometer's sensitivity.

This experiment uses an accelerometer evaluation board with the KXD94 accelerometer, by Kionix, on-board. The actual accelerometer expected to be used for the SmartCane is the MMA2240KEG

accelerometer, by Freescale Semiconductor. The KXD94 has an output sensitivity rating of 200 mV/g. The MMA2240KEG has an output sensitivity rating of 300 mV/g. Consequently, the output signal of the accelerometer actually going to be in the cane can be expected to be an amplified version of this experiment's results. Amplified by 150%.

RESULTS



Figure 3. Analog Output Voltage of the accelerometer undergoing sweeping motion

Here, the output signal provided by the accelerometer moves above and below 2.4 V, the output voltage of the accelerometer when it experiences no acceleration. Two consecutive spikes are observed either above or below the 2.4 V mark before the next spike goes in the opposite direction. The first spike signifies the cane reaching farthest left or right. The ensuing dip signifies the momentary stopping of the cane at that point. The next spike signifies the cane beginning to move away from its farthest point and towards the other direction. Efficient coding would be able to analyze this signal and determine the cane's position by treating the signal like a sine wave, shown below:

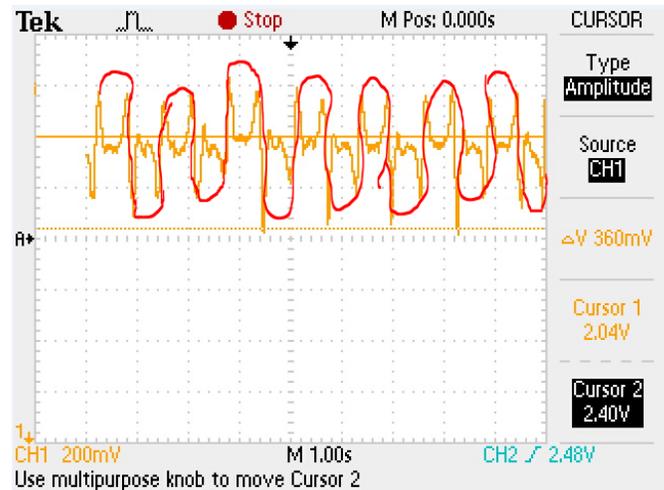


Figure 4. Sinusoidal mapping over acceleration output signal

CONCLUSION

The output signal provided by the accelerometer is sufficient to allow the uController to determine whether the cane is facing the left side, or the right. The output of the accelerometer to be used in the SmartCane will be amplified by 150% in comparison to the outputs shown in the Results section.

Key Hardware Used:

KXD94-2082 Board Evaluation: <http://www.digikey.com/product-search/en?x=22&y=10&lang=en&site=us&Keywords=EVAL-KXD94-2802>