NOVEL POSITION TRACKING METHOD OF A MEDICAL INSTRUMENT

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Introduction

Position tracking or the ability to locate the exact position of a medical instrument inside human body is treated with various ways. The use of X-ray imaging is the dominant method for most of the invasive medical instruments position tracking (Watson and Gorski, 2010), while other methods such as optical or electromagnetic tracking appear as new trends in invasive surgery during the last years. An alternative method for displacement tracking of a medical instrument is presented, able to provide accuracy down to millimeter level, while problems with interference, non-line of sight (LOS), physical size or power consumption are minimized.

Methods

The phase shift of a sinusoidal signal, generated by a transmitter integrated inside a medical instrument can be measured by receivers located at fixed positions outside the patient's body. When the signal frequencies involved are in the GHz range, the aforementioned phase shift can subsequently be interpreted into an exact displacement measurement accurate down to millimeter levels (Boyer and Boyer, 1964).

Results

The displacement of a 10.587 GHz sinusoidal wave transmitter, receding from a fixed positioned receiver is shown to the next plot. A displacement of 8cm for a time period of 2s is presented and the measured precision is in the order of ±1.149 mm.

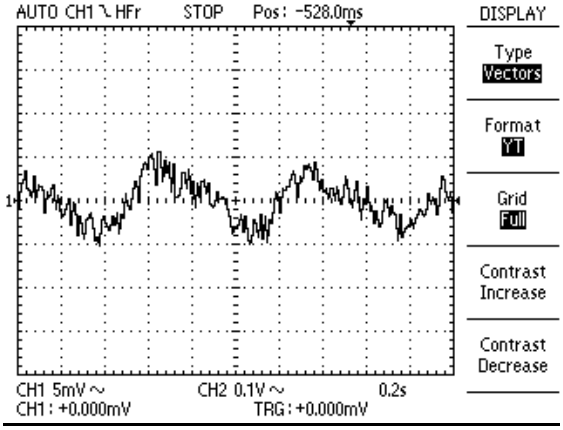

Figure 1: Typical output waveform for 8cm transmitter displacement into 2s time.

Discussion

The aim of this paper is to present a novel position tracking method of an invasive medical instrument into human body. Phase shift method in conjunction with basic PLL philosophy provide a low frequency sinusoidal voltage signal as a system output. This signal can be easily interpreted as the medical instrument displacement measurement using low cost measurement equipment such as an low frequency oscilloscope.

Experiments were performed into free space laboratory environment, thus a phantom based experimental setup is going to provide the final definition and characterization of the system critical performance factors.

References

Boyer, W.D., Boyer, W.D., 1964, Continuous Wave Radar, US pattent number 3155972.

Watson, S., Gorski, K., 2010. Invasive Cardiology: A Manual for Cath Lab Personnel: A Manual for Cath Lab Personnel. Jones & Bartlett Learning.