Test bench for simulating inner body movements

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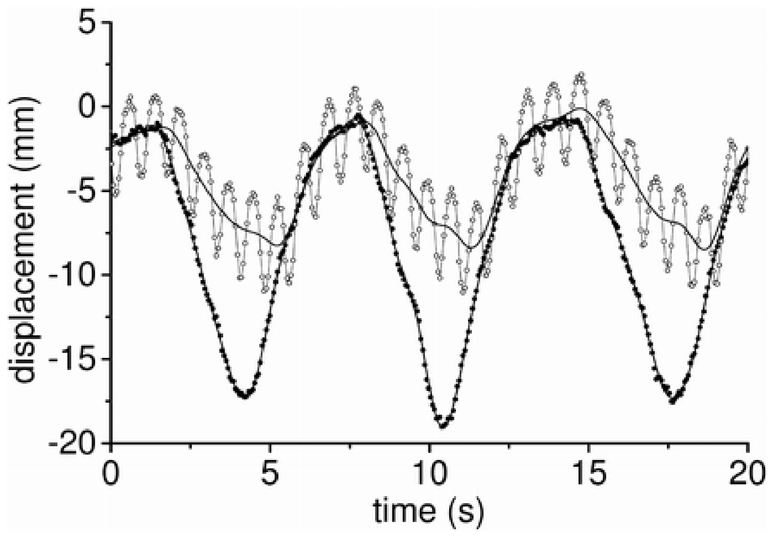
Introduction

- *There is a demand to integrate a sensor into gas-driven implantable infusion pumps to measure the flow.*
- *Sensors inside the pump will be exposed to body movements like breathing, heart beat, sneezing, coughing, speaking, position change.*
- *The aim is to simulate these movements and measure their influence on flow sensors.*

Methods

- *Characterization of inner body movements into three groups: intrafractional movements, interfractional movements, movements due to change of body position [1]*
- *Construct a test bench to simulate these movements*
- *Measure the influence of breathing motion on a flow sensor*

Concept

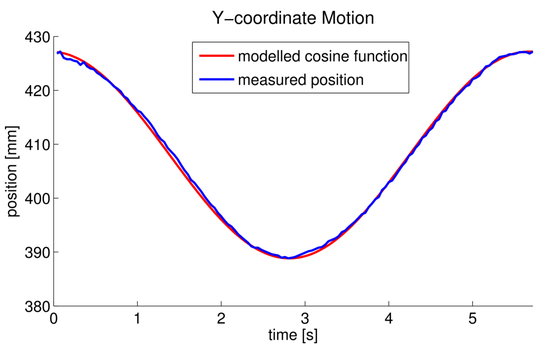


Breathing curve acquired with CT. The (.) shows the motion of the right diaphragm and the (o) shows the motion of the left ventricle. Solid line is low pass filtered motion of the left ventricle (fc = 1Hz) [2].

The standard breathing motion in cranio-caudal direction follows a sinusoidal shape. This motion can be simulated with the test bench.

Results

Test Bench



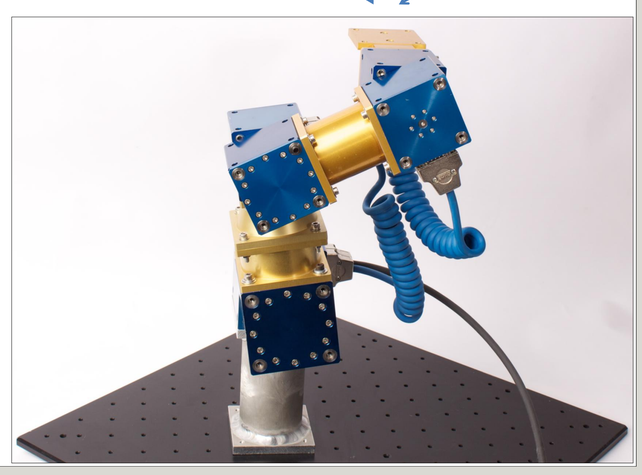
Simulation of the breathing motion with the test bench. Blue curve shows the motion measured with a camera system, red curve shows the cosine function for the input.

Tested motion profiles:

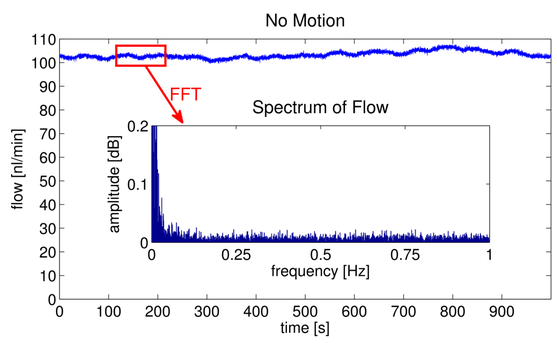
- *Horizontal motion cos(x)*
- *Vertical motion cos(y)*
- *Diagonal motion cos(x,y)*
- *Angle motion*

Constant flow-source

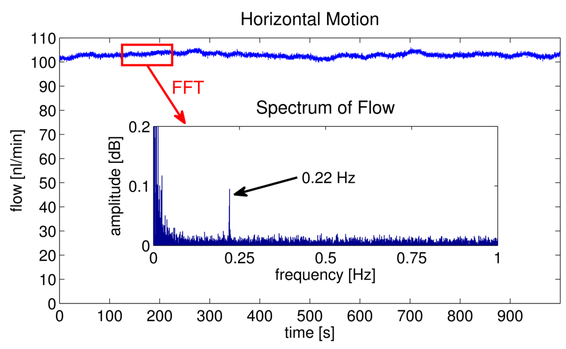
Infusion Pump



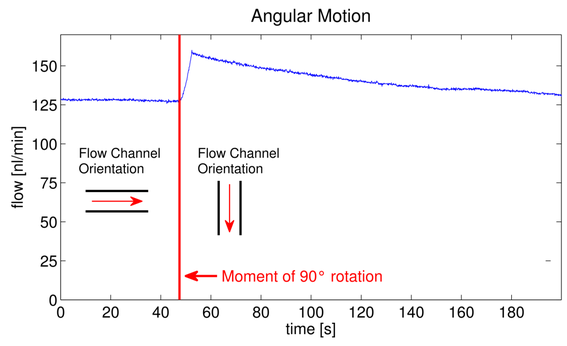
Flow measurement



Measurement with a set flow of 100 nl/min and the respective spectrum with no motion.



Measurement with a set flow of 100 nl/min at a horizontal motion with 0.22 Hz, which can be seen in the spectrum.



Influence on the flow due to a 90° rotation of the fluidic system.

Conclusion

- *Motion has no influence on the average flow, but FFT shows a new oszillation*
- *Angular motion is influenced by gravity*
- *With the developed test bench it will also be possible to examine the general influence of movement on all kind of sensors[3]*

References

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