# On positioning a platform with IPMC muscles

## *System setup*

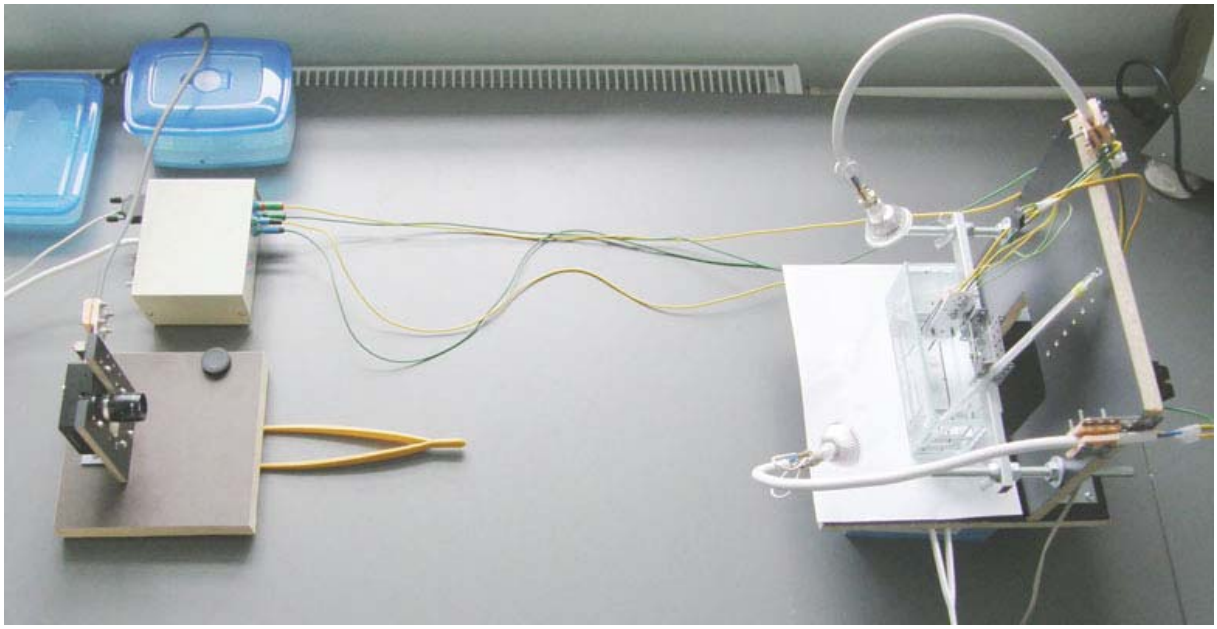
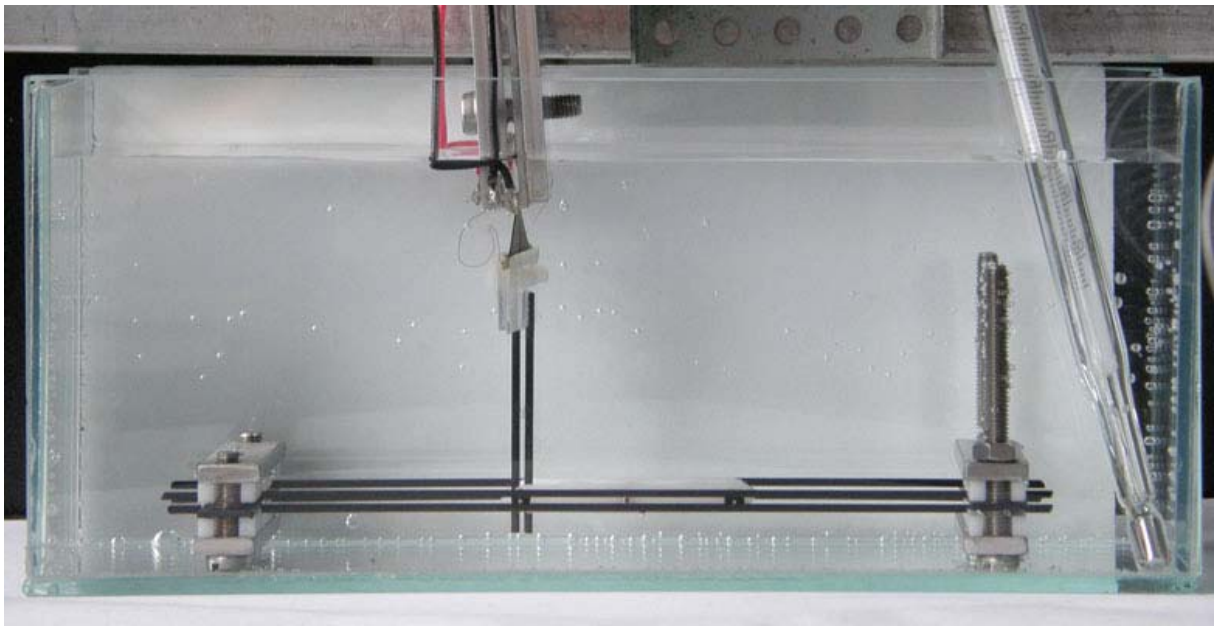
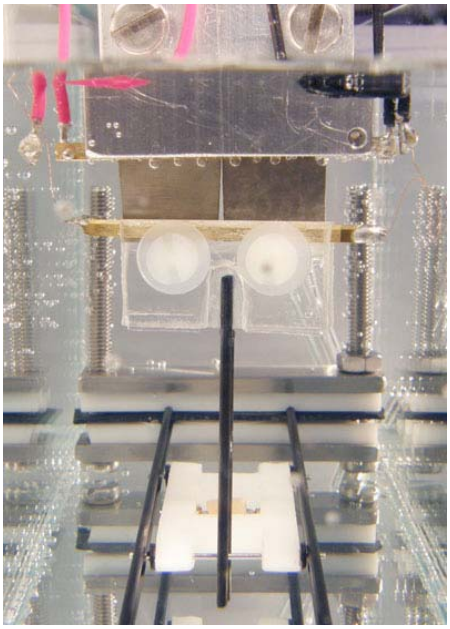


Figure 1. The big picture. The camera is on the left and stage with the IPMC sheet and platform is on the right.



a)

b)



c)

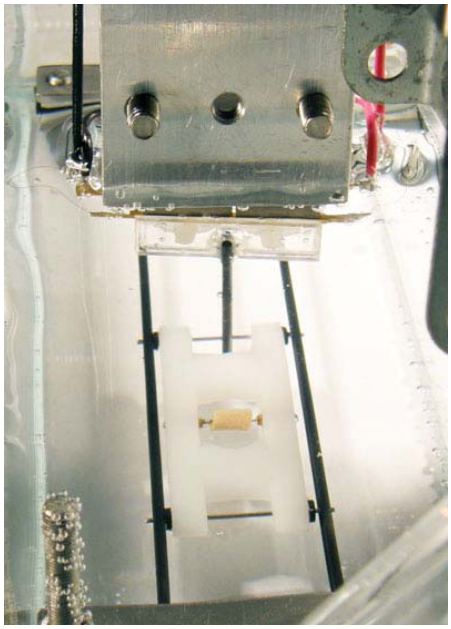


Figure 2. A close-up of the IPMC sheet and platform from front (a) left (b) and right (c)

Dimensions of the free IPMC piece : 7*20mm
Length of the elongation : 40mm
Temperature in the pool : 33 degrees Celsius.

## *Experiment details*

During one episode a sinusoidal voltage was applied to IPMC for 60 s.
For each episode a frequency and amplitude was picked randomly.
Frequencies ranged from 0.1Hz to 10Hz.
Amplitudes 0.50V and 1.00V where tried.
There was 1000 of such consecutive episodes. The experiment takes 20 hours to complete.

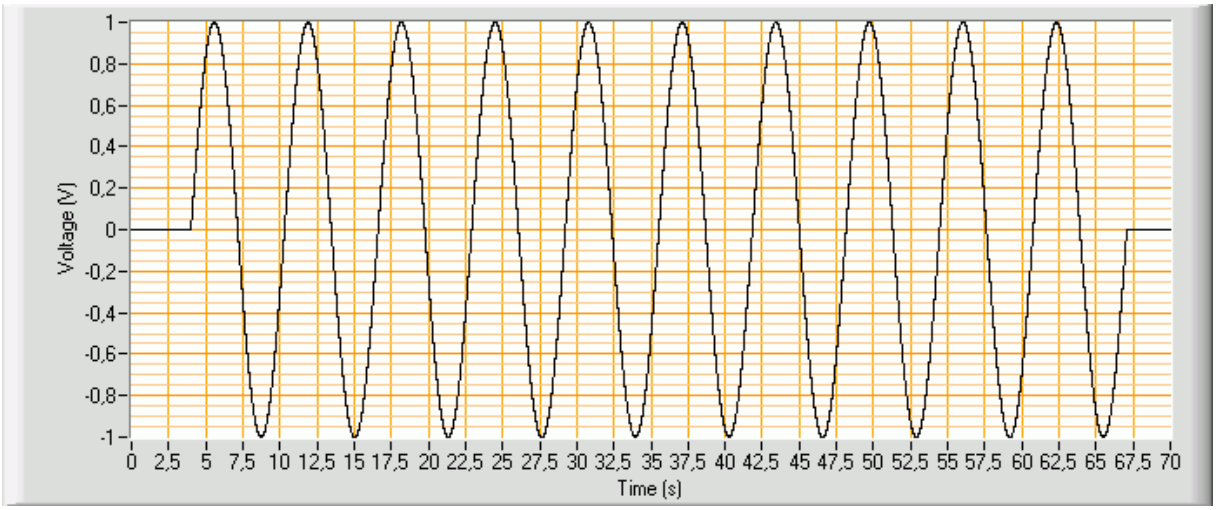


Figure 3. A sample input signal (frequency 0.158562Hz).

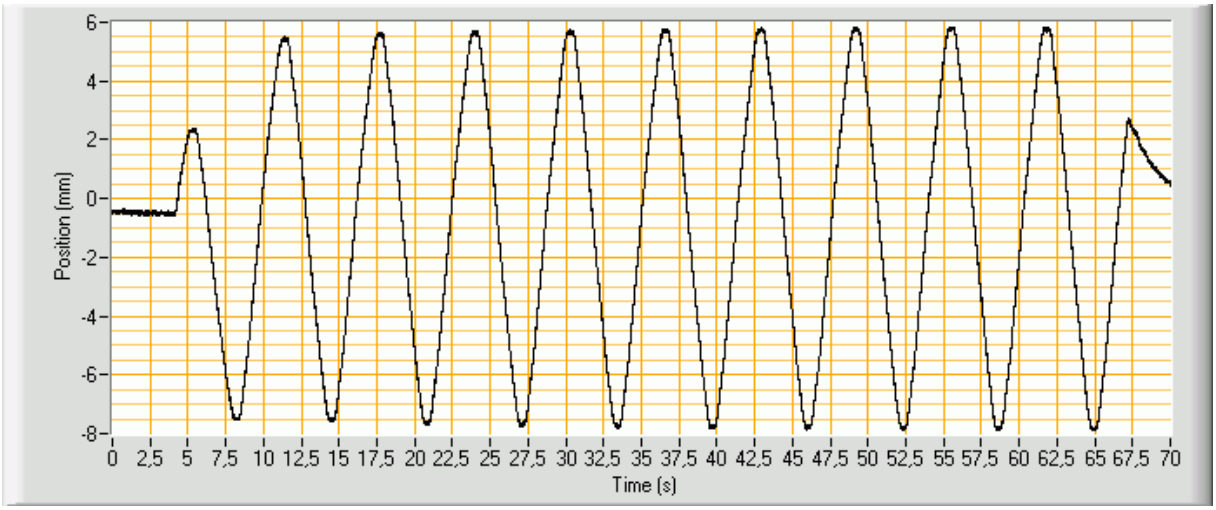


Figure 4. Corresponding output signal.

Please note that on fig. 4 the position of the platform does not harmonic oscillation. It may be an indication of nonlinear behavior of IPMC.

## *Results*

Frequency response of the system was obtained. However as a complex material the measurement depended on both time and max voltage (amplitude). Please pay attention on the voltage and time parameters on top of the graphs.

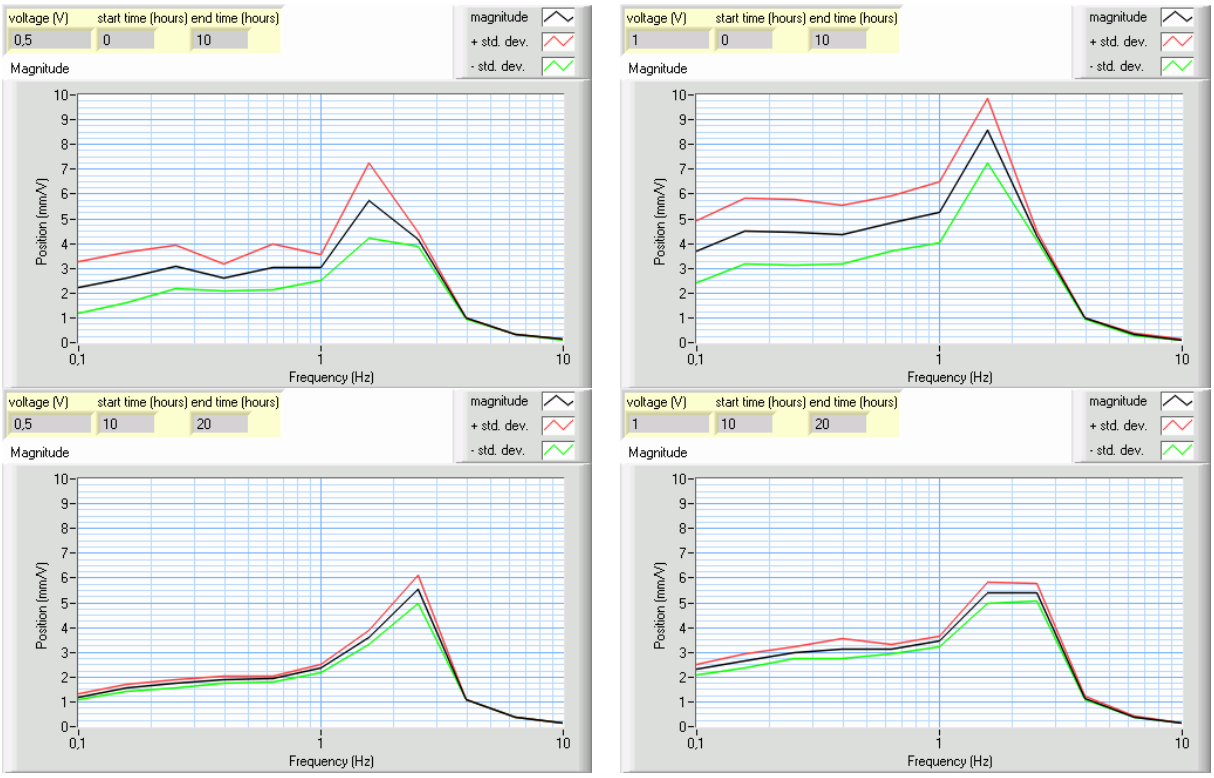


Figure 5. Magnitude

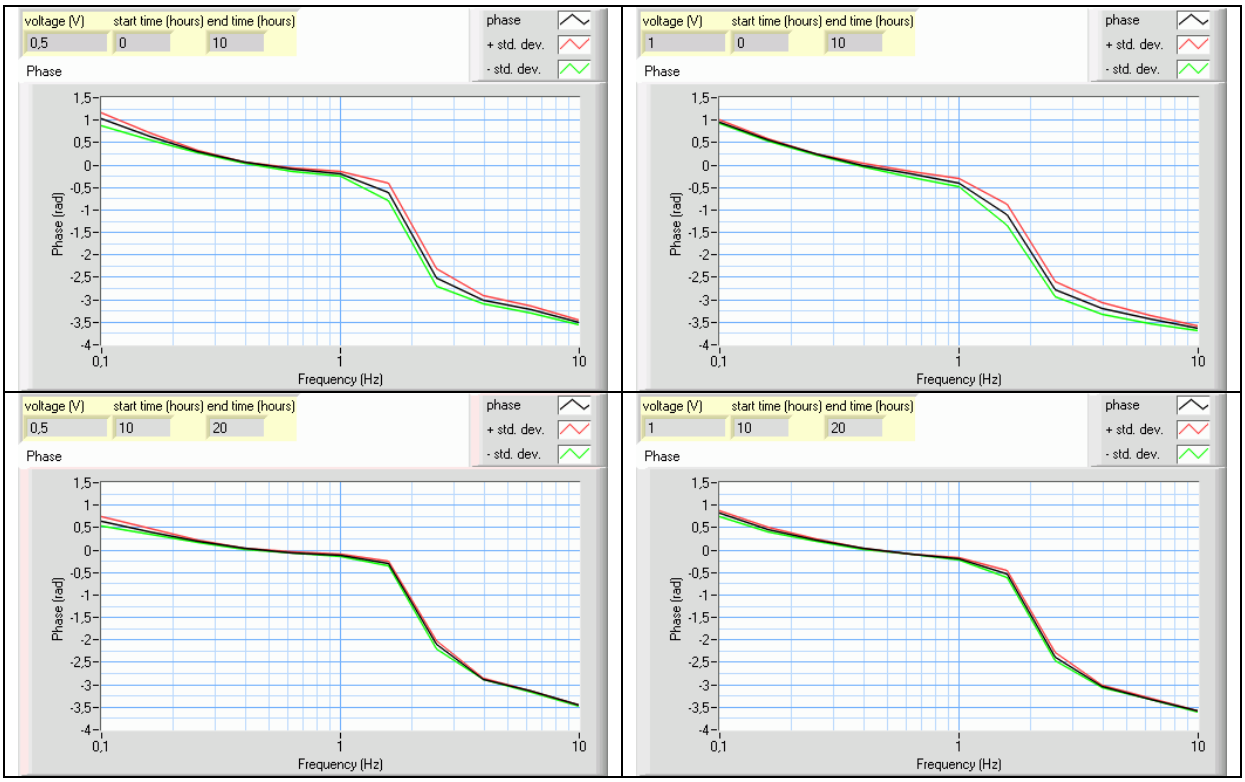


Figure 6. Phase

## *Conclusion*

IPMC is a nonlinear time variant system. However after 10 hours of work the parameters do not change so much any more. At high frequencies the nonlinearity and time invariance is less noticeable.

Phase spectrum did not vary so much.

The phase jump and other experiments not discussed here indicate that there is a pole/eigenfrequency somewhere near 2Hz.