LAB #3 report. MAE 106. UCI. Winter 2005

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1 Answer 1.

The motor velocity control system acts as a low pass filter.

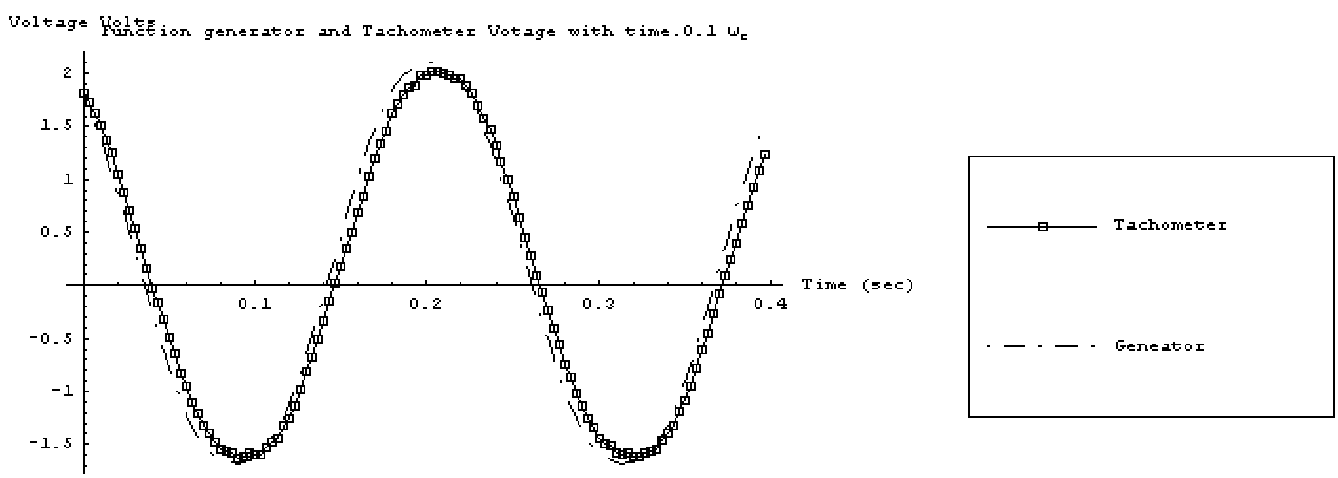
2 Answer 2.

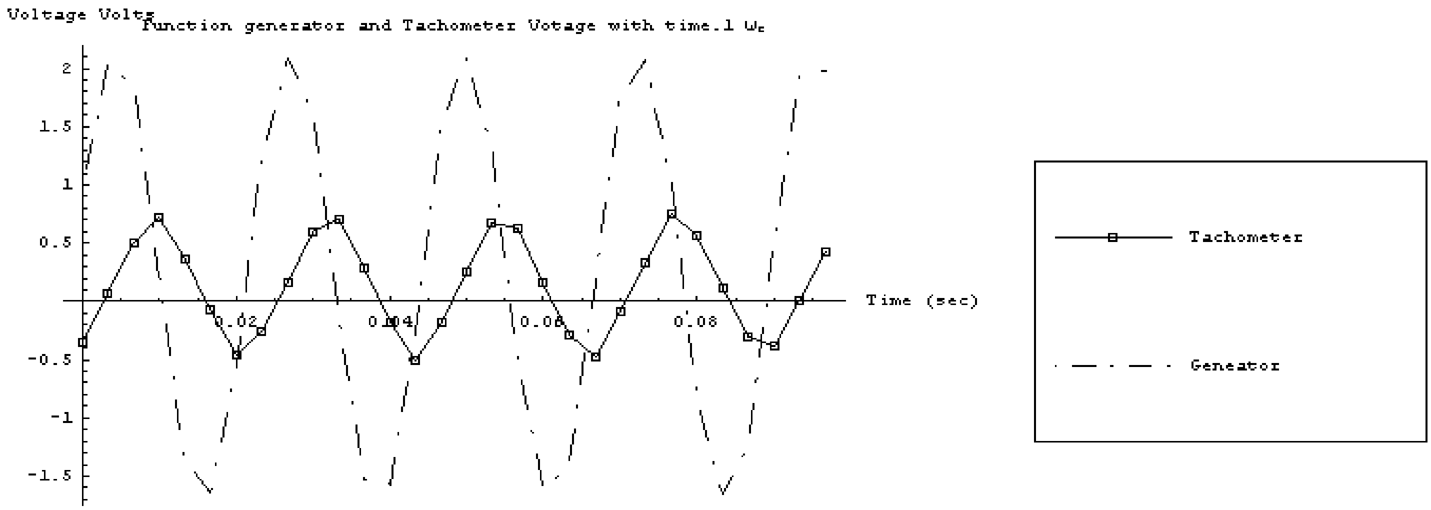
The cutoff frequency used was 44 Hz

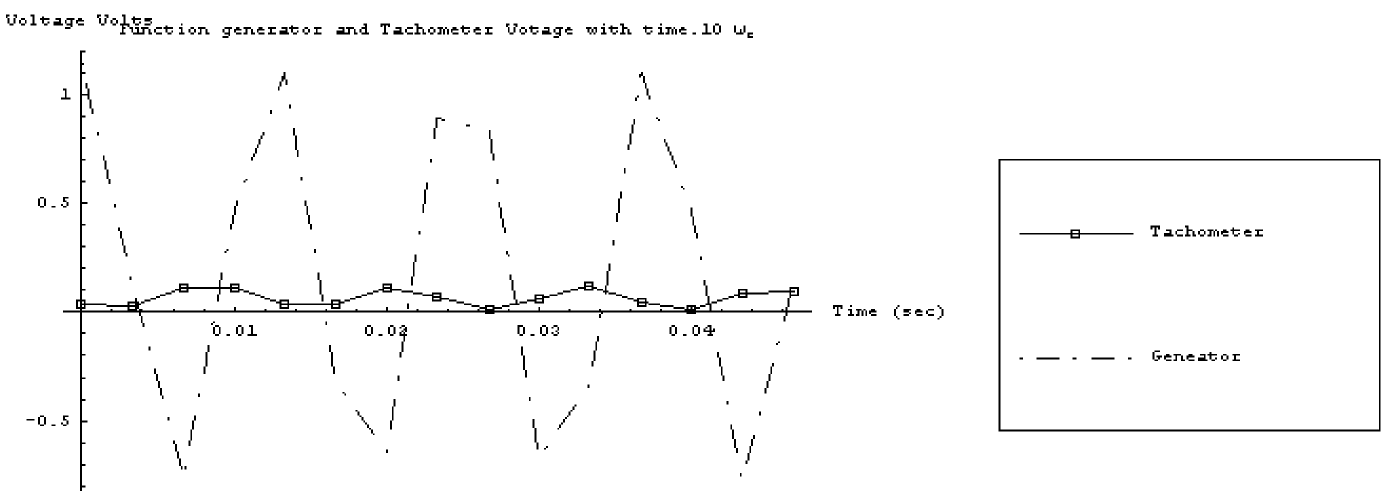
From the 3 data files, I generated 3 plots. One for $0.1\omega_c$ and one for ω_c and one for $10\omega_c$.

From looking at the 3 plots, I see that the output of the tachmeter shows the amplitude is decreasing as the input (function generator) frequency is increasing. This means the controller acts a a low pass filter.

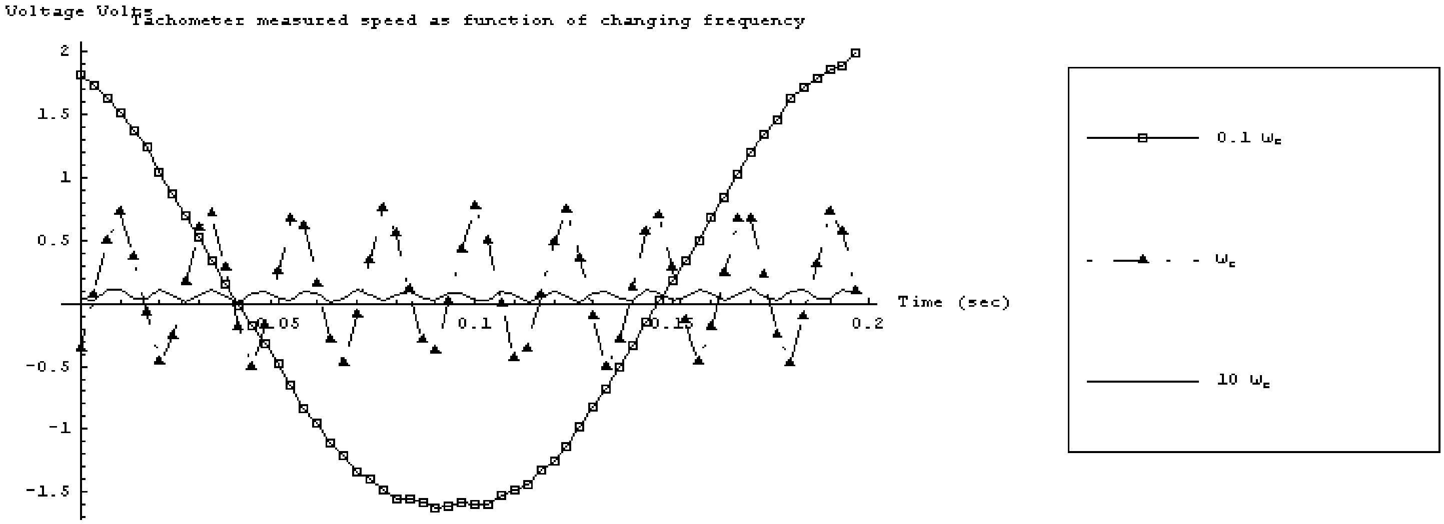
Below are the 3 plots geneated showing on each the actual and the velocity.







To make more clear, I also plot on the same plot, how the actual velocity changes as the input frequency changes. This is the result.



3 Answer 3

$$
\begin{aligned}
\left[k\left(\omega_d-\omega\right)+F_d\right]\frac{k_m}{s} &= \omega \\
\left[k\omega_d-k\omega+F_d\right]\frac{k_m}{s} &= \omega \\
\frac{k\ k_m}{s}\omega_d-\frac{k\ k_m}{s}\omega+\frac{F_d\ k_m}{s} &= \omega \\
\omega\left(1+\frac{k\ k_m}{s}\right) &= \frac{k\ k_m}{s}\omega_d+\frac{F_d\ k_m}{s}
\end{aligned}
$$

Divide by $\left(1+\frac{k\ k_m}{s}\right)$

$$
\omega = \frac{\frac{k\ k_m}{s}\omega_d}{\left(1+\frac{k\ k_m}{s}\right)}+\frac{\frac{F_d\ k_m}{s}}{\left(1+\frac{k\ k_m}{s}\right)}
$$

for $k \gg 1$, $\left(1+\frac{k\ k_m}{s}\right) \approx \frac{k\ k_m}{s}$, hence we get

$$
\begin{aligned}
\omega &= \frac{\frac{k\ k_m}{s}\omega_d}{\frac{k\ k_m}{s}}+\frac{\frac{F_d\ k_m}{s}}{\frac{k\ k_m}{s}} \\
\omega &= \omega_d+\frac{F_d\ k_m}{k\ k_m} \\
\omega &= \omega_d+\frac{F_d}{k}
\end{aligned}
$$

But for $k \gg 1$, $\frac{F_d}{k} \to 0$
hence

$$
\omega \to \omega_d
$$

Hence this shows that by using feeback, and by using very large gain k we can eliminate the effect of the disturbances.