Adaptive filtering

The XEN1210 exhibits a low level of magnetic noise. For Compass applications a simple adaptive low-pass filter can be used to further reduce this noise. The filter can be used for the 3D magnetic vector on separate axis.
A simple recursive low-pass filter is described by the following formula:

$Prediction_n = Factor_n * Sample_n + (1-Factor_n) * Prediction_{n-1}$

$Factor_n$ is now made adaptable and increases with a change in signal. The effect of this action is that the output of the filter tends to follow the input signal in case of of a signal change, but to filter out the noise when there is no change.
Such action can for example be established using the following algorithm:

$Factor_n = ABS((Sample_n - Prediction_{n-1})/Sensitivity)$

For filter stability $Factor_n$ has to remain between zero and one.

$0 < Factor_n < 1$

The higher the sensitivity, the lower the static bandwidth of the filter, but the slower the reaction on a direction change. A good average value of the sensitivity is 8.

In case this filter is implemented in an ASIC or limited processing power is available, some simplifications are allowed. First, only allow Sensitivity to be factors of two, so that the division is a merely a shift action. Also, $Factor_n$ can be clipped on binary values, so also the multiplications can be a limited set of shifts.

The filter can reduce the noise with a factor of five, without any visible reduction in compass speed.

The use of such an adaptive filter in a feedback system has to be considered carefully and simulations are advised.