EE262 Project Proposal: A Low-Bandwidth GmC LowPass Filter

Deborah Won

March 5, 2002

1 Background

Switched capacitor filters have been implemented for filtering of neural signals in the 500Hz-5kHz range in a VLSI neural electrogram recording channel. Because switched capacitor (SC) filtering is a sampled system, an anti-aliasing filter is needed to provide the bandlimited input into the SC filters as well as a reconstruction filter at the SC output. Furthermore, both filters should be fully integrated into the existing prototype channel. For both purposes, a GmC 1st order low pass filter will be designed and implemented in MOSIS AMI 0.5μm technology. The incorporation of these GmC filters into the recording and signal conditioning channel is shown in the block diagram in Fig 1.

2 Preliminary Design

The sampling frequency used in the switched capacitor filters is $f_{clk} = 50$kHz. Also since neural signals of interest may have frequency content up to 10kHz, the targeted cutoff frequency f_0 should be in the range 10kHz $\leq f_0 \leq$ 25kHz. The desired transfer function of the low pass filter with unity gain is:

$$H(s) =$$

ω_0 s+ω_0(1)

The filter in Fig 2 gives the following transfer function for a general first-order frequency response:

$$H(s) =$$

k$_1 s + k_0$ s+ω_0 (2)

where $C_x = k_1$ 1-k$_1 C_A$,

$G_{m1} = k_0 * (C_A + C_x)$, and

$G_{m2} = \omega_0 * (C_A + C_x)$.

Most GmC filters are generally designed to work in high frequency ranges. Thus, obtaining the necessary transconductance for this relatively low-frequency cutoff may prove to be challenging. Initial calculations show a required G_m of roughly .063μS to 0.16μS for C_A=1pF.

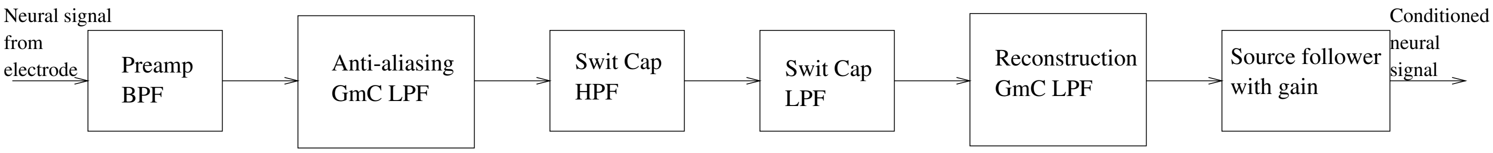

Figure 1: Placement of GmC filters in proposed prototype for a neural signal recording channel

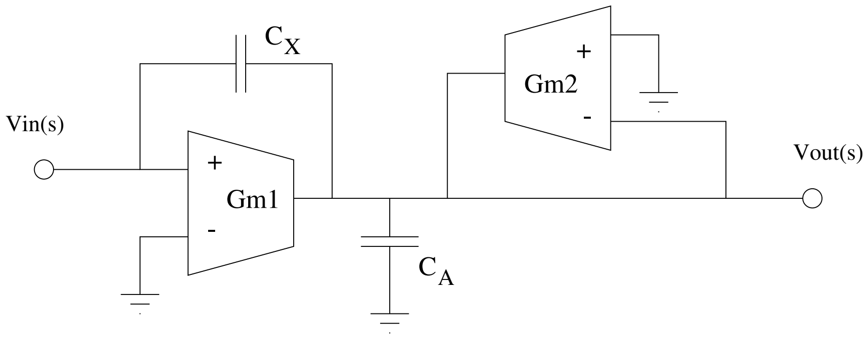

Figure 2: Schematic of a basic first-order G_mC filter