Procedure for offset simulation of a fully differential opamp

This document specifies the procedure to simulate the offset of a fully differential opamp. There are atleast three methods to arrive at the offset of a fully differential opamp and this document starts off by describing one of them.

Method 1: Open loop method

In this method, the opamp is in open loop and the offset is determined by using a procedure similar to simulating offset of a comparator. In the absence of offsets and any applied signal, the output of the opamp is at Vo,cm (output common mode) and differentially at 0V. In the presence of any mismatch and hence offset voltage, the output of the opamp stays at either Vdd or 0 differentially, due to the high open loop gain of the amplifier.

The process of characterization of the offset involves applying a slow varying ramp, with slope m V/s at the input of the opamp differentially. When the differential voltage is 0V, the output differential is 0V when no offset is present. Now when Monte Carlo simulation is enabled for each transient run, the output differential voltage exhibits a spread in time. Since each Monte Carlo run produces a different value for offset voltage, a different value of 2dV is required to null this offset for each run and hence the time at which 2dV assumes the value of offset voltage is different for each run and hence the spread.

Let m be the slope of the voltage dV. Then the time at the which offset is nullified is

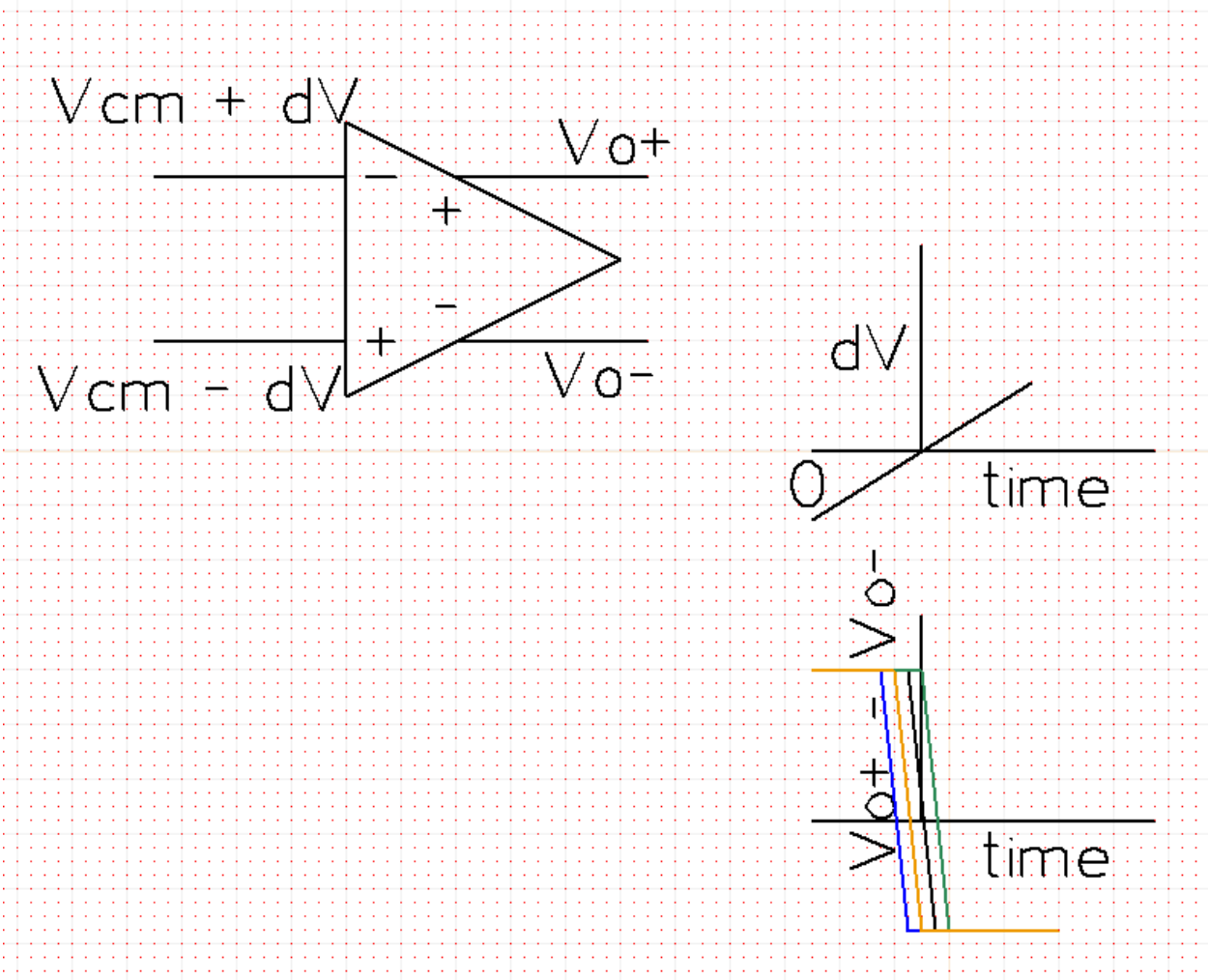
$t = Vos/2m$

The factor 2 in the denominator is to account the fact that 2dV is the differential voltage applied.

From the plot of Vo+ - Vo- vs time, one can obtain the spread and hence the standard deviation of the time it takes for the ramp to reach to Vos. Hence the standard deviation of the offset voltage can be computed as

$\sigma(Vos) = 2m\sigma(t)$

While this approach is the most intuitive way to simulate the input referred offset of the opamp directly, it is computationally ineffective as it uses transient analysis at every Monte Carlo step. The second method that is to be discussed circumvents this problem.



Input referred offset determination for a fully differential opamp