Assignment 11

1 Design Exercises

Feel free to use Multisim to test and confirm your derivations. However, Multisim by itself does not prove anything! We need to see derivations.

1.1 (10 points)

Consider non-inverting amplifier shown in figure 1. Treat the voltage at (V_+) as a desired sensor value. Show expressions for the error signal e and control signal $u(e)$ as functions of the open loop gain A, R_1 and R_2. Assume no delay in response and no frequency dependence in parameters.

Does the schematic has negative (corrective) or positive feedback

1.2 (10 points)

Design a circuit which will maintain a constant illumination on a sensor, i.e. PID circuit. For the sensor use a simple photodiode circuit (Lecture 10 slide 13, left hand side) or if you wish a circuit on the right hand side (i.e. transimpedance amplifier), the more light hits the photodiode, the larger the photocurrent and thus the output voltage. For a light source

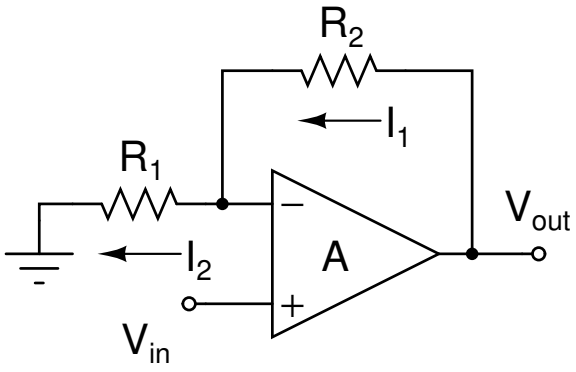

Figure 1: A non-averting amplifier.

use an LED (the more current flows the brighter it is), our can set a desired voltage with a potentiometer (variable resistor). Do not worry about exact values of components draw a general schematic. We will refine the design during the lab.

2 Lab 11: PID

Always start with a circuit diagram and only then build it in hardware.

Your notebooks must be complete, understandable, and address all activities, design exercises, observations, and questions noted in the laboratory's procedures. Remember to use your notebook as a laboratory journal and record your data, design calculations, notes and scratch work. *Make sure to write a conclusion for each exercise and each week.*

Task 0

Demand

- Tutorial about a light sensor based on a transimpedance amplifier.

Task 1 (5 points) LED light source

Build a pulsing light source: connect a square signal functional output of a function generator to a red LED, use a current limiting resistor of about 200 Ω. Set the frequency of the wave to 10 Hz and observe LED pulsation.

Task 2 (15 points) Photodiode

Let's build a transimpedance amplifier with about 10 kΩ transimpedance gain. Check that it works by observing signal from our LED light source.

Task 3 (30 points) PID light level stabilization

Make a PID circuit which maintains a constant light level or at least reduces pulsation induced by the LED light source on a photodiode. Make sure that an instructor approved your results. We might help you with tweaking.