Lab 1: Resistors and Resistive Networks

ENGR 2420 | Olin College

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Experiment 1: Resistive Voltage Division

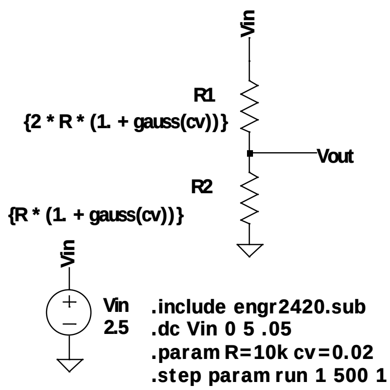

Figure 1: Resistive Voltage Divider Schematic, including LTSpice directives

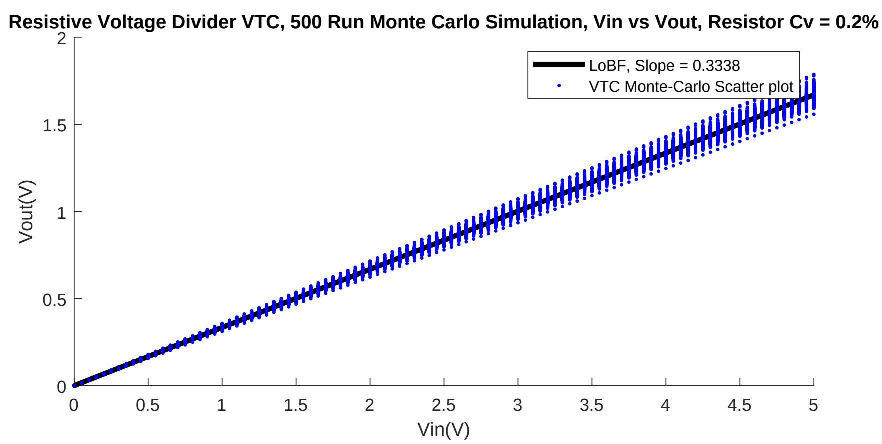

Figure 2: Resistive Voltage Divider Monte-Carlo Simulation VTC Plot with Best Fit

From this Monte-Carlo simulation, we extracted a gain value of $A = 0.3338$ from a single step, compared to theoretical gain of $A = 0.\overline{3}$. Both of these values are incredibly close, which makes sense as we are using fairly low tolerance resistors.

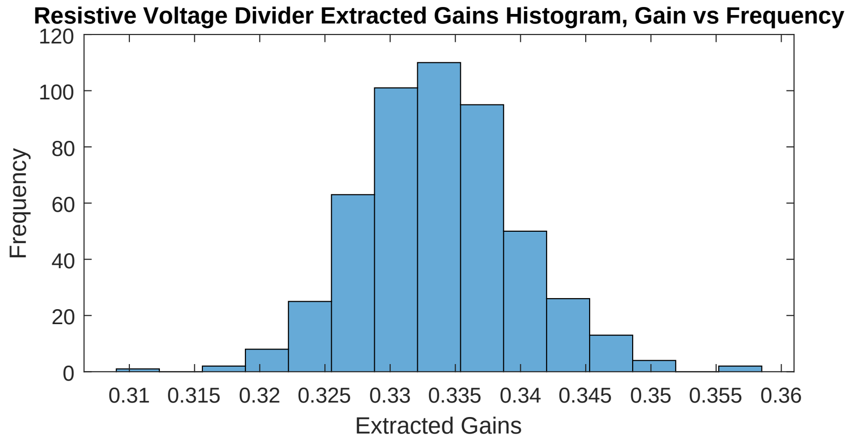

Figure 3: Histogram of the extracted Cv values of the Monte-Carlo Simulation Resistive Voltage Divider

Using the formula for theoretical Cv for a Restive voltage Divider:

$$CV_A = \sqrt{(\frac{-R_1}{R_1 + R_2})^2 \cdot CV_{R_1}^2 + (1 - \frac{R_2}{R_1 + R_2})^2 \cdot CV_{R_2}^2}$$

Results in a theoretical $Cv = 0.019$, Compared to the extracted Cv of the histogram, Calculated using:

$$Cv_A = \sigma_A / \mu_A$$

Which itself results in a $Cv = 0.0182$ Which is also very close to the theoretical Cv.

Experiment 2: Resistive Current Division

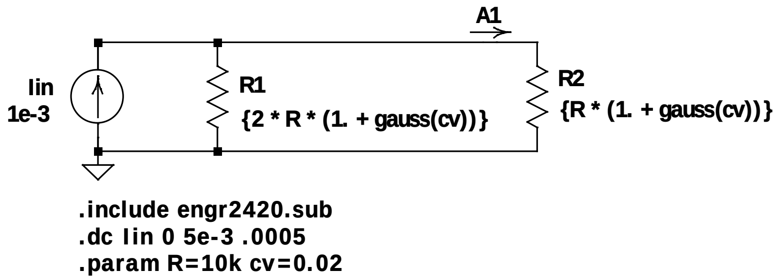

Figure 4: Schematic of Resistive Current divider, including LTSpice directives

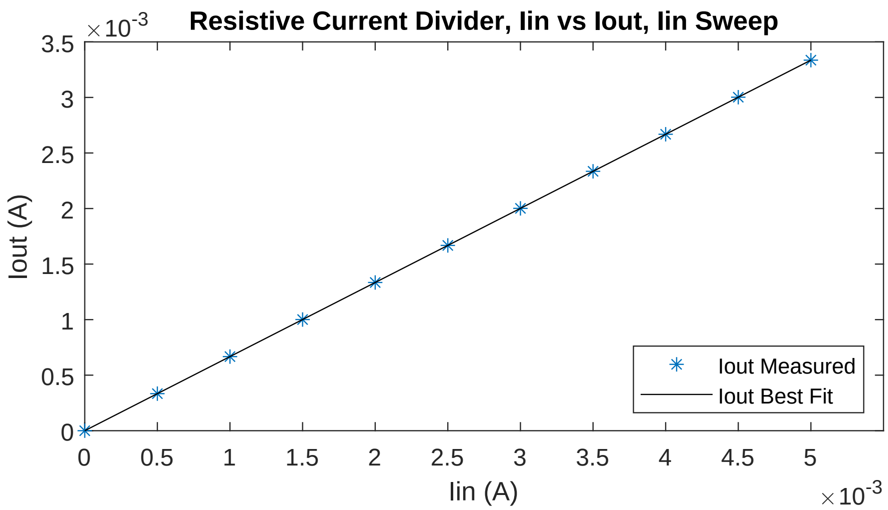

Figure 5: Resistive Current Divider, Measured Vs Theoretical Plot

The Current Divider Ratio A can be calculated using the formula:

$$A = \frac{(R_1 \parallel R_2)}{R_2}$$

Which results in a theoretical gain of $A = 0.\overline{6}$ Extracting the gain from the slope of the best-fit line we arrive at a slope of $A = 0.6671$ which is also very close to the theoretical gain.

Experiment 3: R-2R Ladder Network

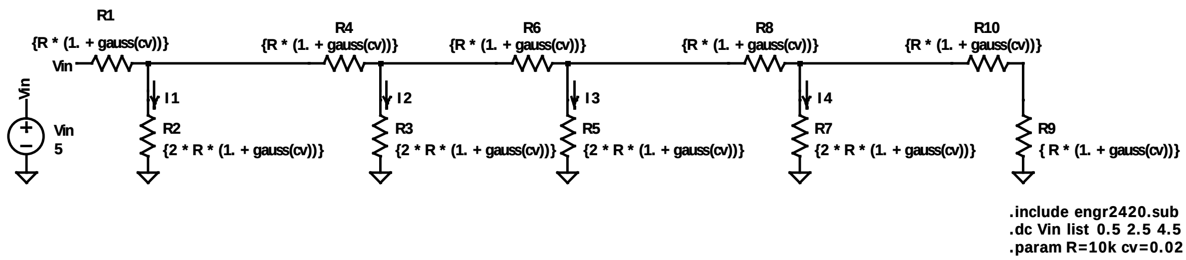

Figure 6: Schematic of R-2R Ladder Network, including LTSpice directives

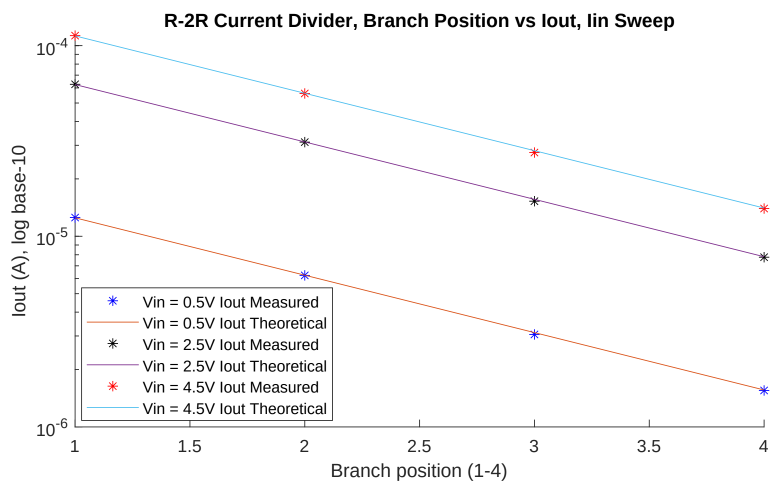

Figure 7: Insert caption

Our recorded (simulated) current values do indeed align with our theoretical values, i.e. the current halves at every branch. According to the formula:

$$I_n = \frac{V}{2^{n+1} \cdot R}$$

This accurately models an N-bit string, where N is our number of branches.