

Circuits

The Big Ideas:

- Most people find their intuition for fluid flow helps in building an intuition for circuits.
- You can use circuits to model large-scale fluid-flow systems, as well as many other systems.
- Circuit systems represent a kind of constraint propagation, as opposed to computation.
- The net flow of electrical current into a node must be zero.
- It is the difference in voltage between two nodes that drives electrical current between the nodes. Absolute voltage is not important (or even well defined). Voltage differences are all that matter.

Introduction

Last week, we finished the signals and systems unit. We also learned how to find the poles of an LTI system and how to use the poles to characterize long-term behavior.

This week, we start a new unit on circuits. The coverage of circuits in 6.01 serves as a survey of introductory concepts for Electrical Engineering, but also demonstrates the utility of the circuits representation for modeling other systems.

Over the next few weeks, you'll review what you know of circuits from 8.02 or an AP physics class, then look at op-amps and more techniques for solving circuits, then look at even more tools for both solving and abstracting away circuits. At this point, it's worth noting we'll be focusing on circuit systems that have linear components and have reached convergence. For those interested, a brief coverage of dynamics is available at the end of Chapter 6.

Vocabulary

In order to engage the material, be able to communicate about the topic with others, and in particular ask questions, we encourage familiarity with the following terms:

Theory

- element
- node
- voltage
- current
- resistance
- conservation laws
 - KVL
 - KCL
- constitutive relation
- source

- volts
- amperes
- resistor
- ohms
- planar circuit
- node voltage

Practice

- Voltage Divider
- Current Divider
- Breadboard
- Power Supply

Check Yourself

Theory: you should understand:

- Basic circuit representation
- KVL, KCL
- Motivations for circuit representation

Practice: you should be able to:

- Solve circuit equations
- Build sensors for your robot
- Use those sensors to collect signals for use in software

Resources

Theory: Chapter 6 of the 6.01 Course Notes is relevant to this week. It deals with circuits: basic analysis, Thevenin/Norton equivalence, and op-amps.

Practice: The 6.01 Software Documentation will come in handy, in particular modules `io` and `optimize`.

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