Numerical Analysis
homework 11: Diode Networks

Due on Tuesday, May 16, 2017

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1 Introduction

To calculate the current of a diode, the formula is:

$$i_d = I_s(e^{\frac{v_d}{\phi}} - 1) \tag{1}$$

$$\phi = \frac{\phi_0 T}{300} \tag{2}$$

where I_s is 1 Amps, ϕ_0 is 0.026 Volts and v_d is the cross-voltage of diode.
In this homework, we will build a Non-linear System to analyze the following diode network.

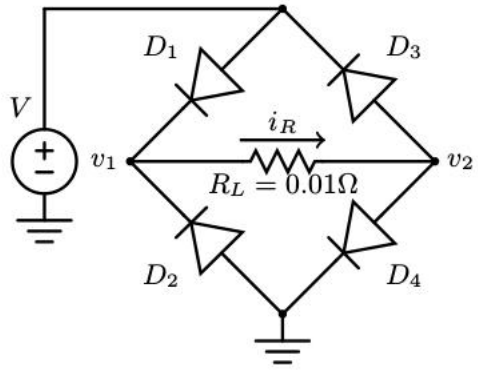

Figure 1: Simple Diode Network

To build a robust function to solve any non-linear system, I use **Finite Difference Approximation** to calculate Jacobian matrix

$$\frac{\partial F}{\partial x} = \frac{F(x+h) - F(x)}{h} \tag{3}$$

1.1 Problems

In this homework, we need to solve two problems:

1. With temperature fixed at 300k, find $v1$, $v2$, i_{D1} , i_{D2}, i_{D3}, i_{D4} and i_R when V = -1.0, -0.98,....., 1 Volt.

2. With initial tamperature is 300k and $v1$, $v2$ are 0 Volt. Find $v1$, $v2$, i_{D1} , i_{D2}, i_{D3}, i_{D4}, i_R, T_{D1}, T_{D2}, T_{D3}, T_{D4} when V = -1.0, -0.99,....., 1 Volt. And the temperature will increase with this formula:

$$T_d = 300 + 2 * i_d * v_d \tag{4}$$

Because Newton Method is sensitive to the initial guess, so we can start solve the system at V = 0 and then solve V = 0.02 which inital guess is the result from V = 0 and so on.

2 Implementation

Algorithm 1 Cyclic Jacobian Updates

Given initial guess x0 and tol
k = 0
while error > tol **do**
  evaluate $F(x0)$
  if k % p == 0 **then**
    calculate Jacobian matrix
  end if
  $J_F(x0)\delta x = -F(x0)$
  $x0 = x0 + \delta x$
  k++
  error = $\|F(x0)\|$
end while