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% Matt McDade
% System Simulation
% Final Exam Problem 1

clear; close all; clc;

N = 1000;
T = 0.1;
t = linspace(0, 10, N);

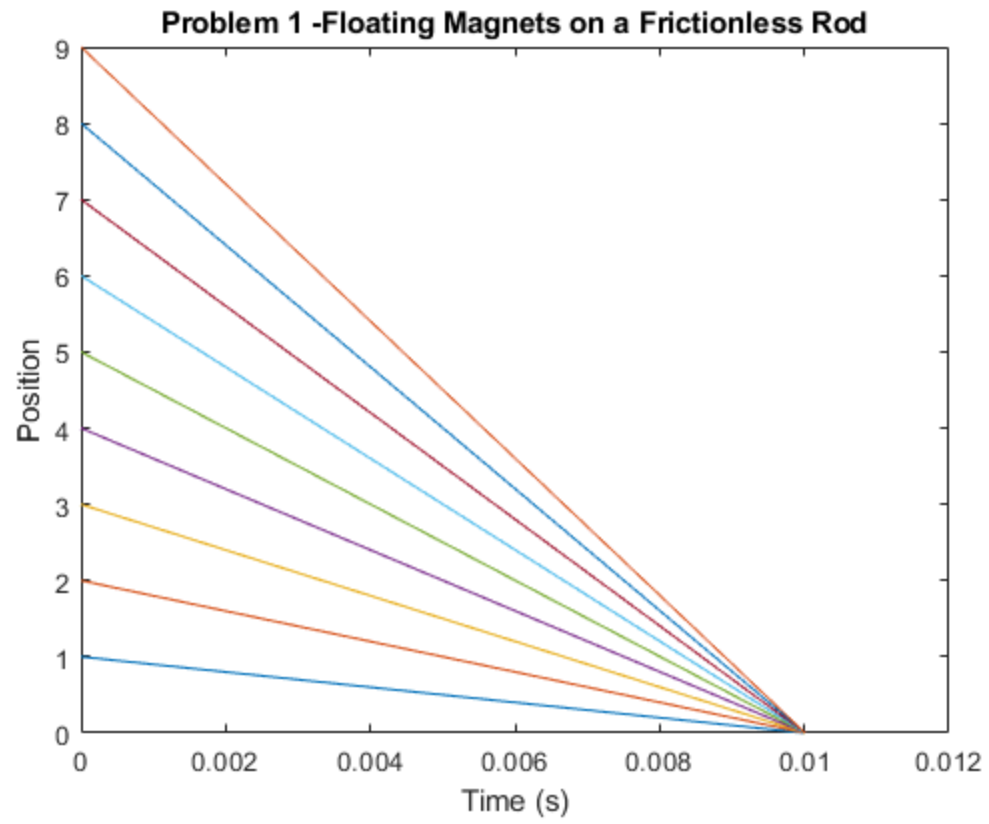
x0 = zeros(1, N); x1 = zeros(1, N); x2 = zeros(1, N); x3 = zeros(1,
    N); x4 = zeros(1, N);
x5 = zeros(1, N); x6 = zeros(1, N); x7 = zeros(1, N); x8 = zeros(1,
    N); x9 = zeros(1, N);
x10 = 10 * ones(1, N);

x0(1) = 0; x1(1) = 1; x2(1) = 2; x3(1) = 3; x4(1) = 4;
x5(1) = 5; x6(1) = 6; x7(1) = 7; x8(1) = 8; x9(1) = 9;

for k = 2:N-1
    f1 = -1 + (1/(x1(k) - x0(k))^2) - (1 / (x2(k) - x1(k))^2);
    f2 = -1 + (1/(x2(k) - x1(k))^2) - (1 / (x3(k) - x2(k))^2);
    f3 = -1 + (1/(x3(k) - x2(k))^2) - (1 / (x4(k) - x3(k))^2);
    f4 = -1 + (1/(x4(k) - x3(k))^2) - (1 / (x5(k) - x4(k))^2);
    f5 = -1 + (1/(x5(k) - x4(k))^2) - (1 / (x6(k) - x5(k))^2);
    f6 = -1 + (1/(x6(k) - x5(k))^2) - (1 / (x7(k) - x6(k))^2);
    f7 = -1 + (1/(x7(k) - x6(k))^2) - (1 / (x8(k) - x7(k))^2);
    f8 = -1 + (1/(x8(k) - x7(k))^2) - (1 / (x9(k) - x8(k))^2);
    f9 = -1 + (1/(x9(k) - x8(k))^2) - (1 / (x10(k) - x9(k))^2);

    x1(k+1) = -2 * x1(k) - x1(k-1) - T^2 * f1;
    x2(k+1) = -2 * x2(k) - x2(k-1) - T^2 * f2;
    x3(k+1) = -2 * x3(k) - x3(k-1) - T^2 * f3;
    x4(k+1) = -2 * x4(k) - x4(k-1) - T^2 * f4;
    x5(k+1) = -2 * x5(k) - x5(k-1) - T^2 * f5;
    x6(k+1) = -2 * x6(k) - x6(k-1) - T^2 * f6;
    x7(k+1) = -2 * x7(k) - x7(k-1) - T^2 * f7;
    x8(k+1) = -2 * x8(k) - x8(k-1) - T^2 * f8;
    x9(k+1) = -2 * x9(k) - x9(k-1) - T^2 * f9;
end

plot(t, x1, t, x2, t, x3, t, x4, t, x5, t, x6, t, x7, t, x8, t, x9)
xlabel('Time (s)')
ylabel('Position')
title('Problem 1 -Floating Magnets on a Frictionless Rod')
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