MAE 511 HW Set 2

Due Sept 10, 2018 by 3pm

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1a) Use Mathematica™ to multiply the rotation matrices found in equations 3.17, 3.19, 3.20 of the Meirovitch text, in the following order: [3.20][3.19][3.17], i.e. $[R_3(\theta_3)][R_2(\theta_2)][R_1(\theta_1)]$ using Meirovitch's notation (we will be developing a slightly different notation in class to represent these matrices).

1b) Use Mathematica™ to find the inverse of the matrix found in problem **1a** above.

1c) Treating the variables θ_1, θ_2 and θ_3 as functions of time, use Mathematica™ to find the time derivative of the matrix found in problem **1b** above.

1d) Use Mathematica™ to find the matrix resulting from multiplying together the matrices found in problems **1a** and **1c** in the following order:

[Answer to problem **1a**][Answer to problem **1c**].

Solution:

The 3 rotation matrices are defined as R1(θ_1), R2(θ_2) and R3(θ_3) respectively.

1a) A1 = R3.R2.R1
This matrix (A1) is displayed using the MatrixForm command.

1b) B1 = Inverse[A1]

1c) C1 matrix is the derivative of B1. The function Dt[B1,t] is used to find the derivative with respect to time (t). This matrix is displayed using the TraditionalForm command, as it shows the output in the most compact notation.
Since the matrix contains large terms, it does not fit on the output screen completely. So, each column is displayed individually using the C1[All, 1] for the 1st column, C1[All, 2] for the 2nd column and C1[All, 3] for the 3rd column.
C1 = [C1[All,1] , C1[All,2] , C1[All,3]]

(The first 3 commands on the second page show these column matrices)

1d) D1 = A1.C1

2a-2b) Repeat steps **1a and 1b**, starting with multiplying the matrices found in equations 3.17, 3.19, 3.20 of the Meirovitch text, in the following order: [3.17][3.19][3.20] for **2a**.

Solution:

Here A2 = R1.R2.R3 and its inverse is calculated using the same steps followed in question 1.

The value of the inverse is stored in matrix B2.

3a-3d) Repeat steps **1a-1d**, starting with multiplying the rotation matrices found in equations 3.4-1, 3.4-2, and 3.4-3 of the Thomson text, in the following order:

[3.4-3][3.4-2][3.4-1], i.e. [φ matrix][θ matrix][ψ matrix]

Solution:

R1 = ψ matrix

R2 = θ matrix

R3 = φ matrix

The steps from question are repeated, with the output values stored in A3, B3, C3 and D3 respectively.

Since the elements of C3 are large, each column is displayed separately.

C3 = [C3[All,1] , C3[All,2] , C3[All,3]]