

ELEC 341 – Graded Assignments

Assignment A4
Block Diagram Manipulation

10 Marks

Learning Objectives

Block Diagram Manipulation	Matlab
Model Simplification	feedback()
Loaded Electric Motors	Simulink
Motor Model with Feedback	

The “**MIMO Block Diagram**” has 2 inputs and 2 outputs.
Assume uniform physical units, so the transfer function is pure.

Q1 4 mark(s) Block Diagram Manipulation

Use block diagram manipulation to find each G.
Use **minreal()** to simplify each transfer function.

- G11

Input = U1 Output = Y1
- G12

Input = U1 Output = Y2
- G21

Input = U2 Output = Y1
- G22

Input = U2 Output = Y2
- Q1.G11

(pure)

LTI
- Q1.G12

(pure)

LTI
- Q1.G21

(pure)

LTI
- Q1.G22

(pure)

LTI

Q2 2 mark(s) MISO Systems

Compute each G that corresponds to a common input signal applied to both inputs.
Use **minreal()** to simplify each transfer function.

- G1

Input = Both

Output = Y1
- G2

Input = Both

Output = Y2
- Q2.G1

(pure)

LTI
- Q2.G2

(pure)

LTI

MIMO Block Diagram

- G1 = 1/(s+#A)

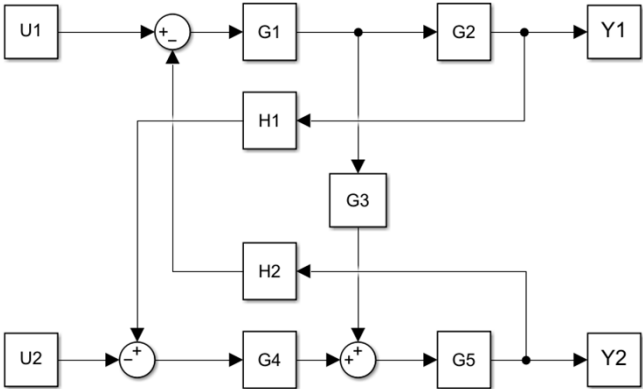
• G2 = 10/(s+#B)

• G3 = 10/(s+#C)

• G4 = 10/(s+#D)

• G5 = 1/(s+#E)
- H1 = 100/(s+#F)

• H2 = 1000/(s+#G)



COW: Implement the “MIMO Block Diagram” in Simulink.

Simulink is a Matlab GUI. Draw the figure **EXACTLY** as shown and press “RUN”.

If your Matlab solution is correct, you will get the **EXACT SAME** response in Simulink.

Even though I used Simulink to draw the “MIMO Block Diagram”, I didn’t use the correct blocks because it didn’t look as clean. A correctly implemented system is shown here, with step inputs applied. The switches let me check **ALL** my solutions for Q1 & Q2.

Test SN = 86753099



A fan is a simple electro-mechanical system comprising a motor and a fan blade. The fan blade has inertia and damping due to air resistance, and that's it. Your motor from Assignment 3 has a fan blade attached as shown in "Fan Motor".

Q3 4 mark(s) Fan Motor

Compute the electrical Y_e and mechanical Y_m admittance functions shown. Then use **feedback()** to compute the transfer function G . Use **minreal()** to simplify each transfer function.

Y_e	Input = V_{in}	Output = I_w
Y_m	Input = τ	Output = ω
G	Input = V_{in}	Output = ω
• Q3. Y_e	(A/V)	LTI
• Q3. Y_m	(rad/Nms)	LTI
• Q3. G	(rad/Vs)	LTI

COW: Set the fan parameters to zero and compare to Assignment 3. Did the speed go up or down after attaching the fan ??? Reasonable amount ??? Why not double-check by building it in Simulink ???

Fan Motor

- $J_f = \#G/30$ (μNms^2)
- $B_f = \#H \times B_r$ (μNms)
- B_r = rotor damping from Assig. 3

