16. 400   AEROSPACE HUMAN FACTORS ENGINEERING

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HOME PROBLEM 2   **MANUAL CONTROL**

1.   **BACKING UP**
Consider the problem of backing an automobile down a winding driveway, unknown to the driver, and surrounded by very expensive and rare trees. The driver would like to back down the drive as quickly as possible.

Assume the following for the automobile:
        Length= 20ft.
        Width = 6 ft.
        Maximum deflection of front wheels = 45 deg.
        Steering wheel ratio: 2 turns from stop to stop
Assume the following for the roadway:
        Length = 200 ft.
        Width = 12 ft.
        Random curves, described by a spatial frequency power which is FLAT from 0 to 0.1 (lateral deflection/distance along the drive) and null beyond 0.1
For simplicity, keep the speed constant at a velocity V which you are to choose.

First model the controlled element as an appropriate transfer function.

Next model the driver's quasi-linear describing function, including remnant, for a very slow speed.

What is the crossover frequency. phase margin and effective time delay for you assumed models.

Finally select a speed, V, which will lead to tracking behavior such that the wheels go off the edge of the drive very rarely.

2.   **DRIVER'S HELPER**
 Invent a display to help the driver achieve his goal more easily. Describe what information is to be displayed, how it might be gathered and how it might be displayed. How does your display change the operator model and the error at speed V?

3.   **BACKING A TRAILER**
Now to make matter worse, the driver must back down the same driveway with a trailer attached. Assume that the distance from the trailer hitch to the trailer wheels is 15 ft, and that the trailer is the same width as the auto. Repeat all the calculations of problem 1 and invent a display as in problem 2.

(For each problem draw a block diagram and illustrate your calculations and claims with sketches of frequency responses. Justify all assumptions.)