# Longitudinal Flight Dynamics

# -Longitudinal state space model for aircraft linearized equations of motion:-

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**- Eigenvalues**

**- Eigenvectors**

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**longitudinal modes approximations**

**-short-period mode Approximation characteristics:-**

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-state space+

- Eigenvalues\_short period Approximation

- Eigenvectors\_short period:-

**long-period mode Approximation**

, ,

State Space

- Eigenvalues\_short period:-

- Eigenvectors\_short period:-

**The Transfer functions**

**Linear full model**

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|  | **𝛿𝑒** | **𝛿𝑡ℎ** |
| **u** | 2.54 s^3 + 386.4 s^2 + 334 s + 136.6  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 | 0.000842 s^3 + 0.00151 s^2 + 0.00552 s + 0.0001142  --------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 |
| **w** | -34.6 s^3 - 5251 s^2 + 2.548 s - 2.827  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 | -0.004692 s^2 - 0.002775 s + 1.688e-06  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 |
| **q** | -6.77 s^3 - 4.257 s^2 - 0.00888 s - 1.203e-19  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 | -6.04e-06 s^3 - 7.587e-06 s^2 - 2.163e-06 s -----------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 |
| **θ** | -6.77 s^2 - 4.257 s - 0.00888  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 | -6.04e-06 s^2 - 7.587e-06 s - 2.163e-06  ------------------------------------------------  s^4 + 1.387 s^3 + 5.963 s^2 - 0.2114 s - 0.08247 |

**For Short period mode**

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|  | **𝛿𝑒** | **𝛿𝑡ℎ** |
| **w** | -34.6 s - 5251  ---------------------  s^2 + 1.387 s + 6.203 | -0.004662  ---------------------  s^2 + 1.387 s + 6.203 |
| **q** | -6.77 s - 4.246  ---------------------  s^2 + 1.387 s + 6.203 | -6.04e-06 s - 4.017e-06  -----------------------  s^2 + 1.387 s + 6.203 |

**For long period mode**

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|  | **𝛿𝑒** | **𝛿𝑡ℎ** |
| **u** | 2.54 s  ---------------------------  s^2 + 2.11e-06 s + 0.001447 | 0.000842 s  ---------------------------  s^2 + 2.11e-06 s + 0.001447 |
| **θ** | 0.0001145  ---------------------------  s^2 + 2.11e-06 s + 0.001447 | 3.796e-08  ---------------------------  s^2 + 2.11e-06 s + 0.001447 |

**Root locus plots**

