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PROOF:

Now focus on the green terms

Since each of these two terms is scalar, each can be transposed. Let’s transpose the first term.

Now focus on the blue terms,

Since each of these two terms is scalar, each can be transposed. Let’s transpose the first term.

Now let us focus on the derivative of T2 wrt t

Using Leibnitz integral formulas,

Now let us focus on the derivative of T3 wrt t

By using Leibnitz’s integral formulae,

As a result of this,

And

Now let us focus on the red-terms,

|  |  |
| --- | --- |
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|  |  |
| --- | --- |
| Now by using Cauchy-Schwarz |  |

Therefore,

And the red terms are eliminated,

Now let us focus on the blue-terms,

This inequality is obtained by the same technique applied to the red-terms.

Therefore,

And since

For this term to be negative-definite, the RHS-matrix must be negative-definite

By pre- and post-multiplying the LHS, and denoting

Now define,

|  |  |
| --- | --- |
|  |  |

Finally, the delay-dependent LMI condition is given by

Therefore, the LMI conditions are given as,

Delay Independent LMI Condition

|  |  |
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PROOF:

Let us obtain time-derivative of Lyap-fcn wrt the time

By using Leibnitz’s integral formulae,

and

And since is required for the stability, RHS matrix must be negative-definite,

Therefore, the conditions are given as