**Q1:**

A stabilizable system will reach the desired state for a control input . If the a system is not stabilizable no minimum of the LQR problem can be found since the state cost will increase continuously.

A reachability test could be performed since a reachable system is also stabilizable. Reachability is a necessary condition for stabilizability. Therefore, the full rank of the controllability Matrix or the PBH test is to be checked.

The PBH test for reachability is performed: A system (A, B) is unreachable if and only if there exists a left hand eigenvector with such that

and .

The calculation delivers the following eigenvalues:

As a result, the system is reachable and since the reasoning above it’s also stabilizable.

**Q2:**

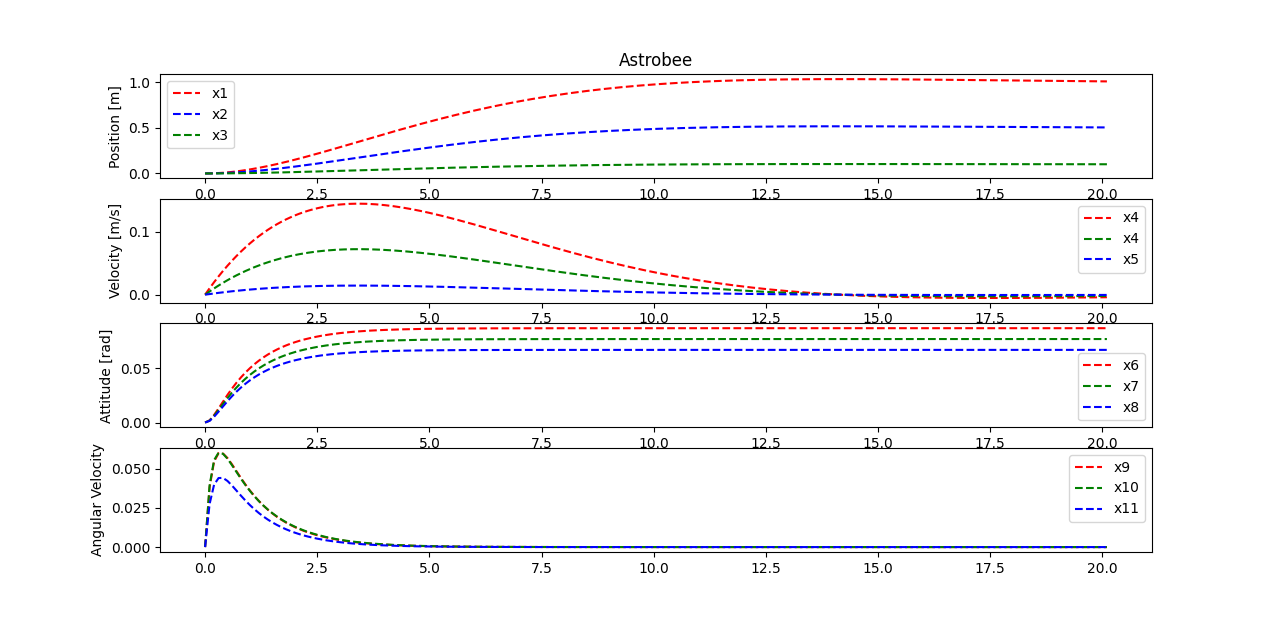


Figure : Astrobee states over simulation time

**R = 10:**

By multiplying the R matrix by factor 10 the control input is penalized stronger so that smaller control values are calculated. As a result, it the time to reach the desired states is increased since the focus is on low control input, see figure 2.

Ein Bild, das Text, Reihe, Diagramm, Screenshot enthält.

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Figure : Astrobee with R = 10

**Q[3:6] = 100 and Q[9:] = 100:**

By increasing the two single Q entries…

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Figure : Astrobee with Q[3:6] = 100 and Q[9:] = 100

**Penalization of position and attitude with 100:**

By high penalization of position and attitude these state are reach in short time, since in minimum ins only found if these variables are reaching their desired state as fast, see figure 4.

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Automatisch generierte Beschreibung

Figure : Astrobee with 100 penalized position and attitude