Unit Test Documentation for Four-Bar Linkage

October 13, 2024

Overview of the Test Collection

The unit tests for the Four-Bar Linkage system are designed to verify the correct classification of linkage motion types. Each test checks whether the linkage is correctly identified as a specific combination of crank, rocker, and intermediate states based on the values of T_1, T_2, and T_3. These tests ensure that for various configurations of the four-bar linkage, the input and output links are classified accurately. The classifications are important for understanding the behavior of the system and ensuring correct functionality in different scenarios.

The test cases systematically cover all possible combinations of positive, negative, and zero values for the parameters T_1, T_2, and T_3, ensuring that every possible motion configuration is tested. The expected outcomes are predefined according to the known behavior of four-bar linkages.

Explanation of Test Collection

Each collection of test cases verifies a specific motion classification of the four-bar linkage system. The classifications generally fall into the categories of Crank, Rocker, and intermediate states like π-rocker or 0-rocker.

Crank-Rocker Classifications

The tests in this group verify the combinations where one of the links acts as a crank while the other behaves as a rocker.
- **test_case_1**: Tests a scenario where all the parameters T_1, T_2, and T_3 are positive. The expected classification is crank for the input link and rocker for the output link.
- **test_case_4**: Verifies the scenario where $T_1 > 0$, $T_2 = 0$, and $T_3 > 0$, leading to a crank on the input and 0-rocker on the output.
- **test_case_10**: Tests the scenario where $T_1 > 0$, $T_2 > 0$, and $T_3 = 0$. The input link is classified as a crank and the output as π-rocker.

Double Crank and Crank-Crank Classifications

These tests ensure that the linkage behaves as a double crank or crank-crank system, where both the input and output links are classified as cranks.
- **test_case_5**: Tests the scenario where both T_1 and T_2 are zero, and $T_3 > 0$. Both the input and output links are classified as cranks.
- **test_case_6**: Verifies that when $T_1 < 0$, $T_2 = 0$, and $T_3 > 0$, both links behave as cranks.
- **test_case_13**: Tests the case where all values $T_1 > 0$, $T_2 = 0$, and $T_3 = 0$ lead to a crank-crank configuration.
- **test_case_17**: Checks that when $T_1 = 0$, $T_2 < 0$, and $T_3 = 0$, the classification is crank-crank.

Double Rocker Classifications

The following tests verify configurations where both the input and output links behave as rockers.
- **test_case_3**: Tests the scenario where $T_1 < 0$, $T_2 > 0$, and $T_3 > 0$, which results in both the input and output links being classified as π-rockers.

- **test_case_24**: Tests the scenario where $T_1 < 0$, $T_2 = 0$, and $T_3 < 0$, resulting in both the input and output links classified as 0-rockers.
- **test_case_21**: Verifies that when $T_1 < 0$, $T_2 > 0$, and $T_3 < 0$, both the input and output links are classified as rockers.

Rocker-Crank Classifications

These tests check situations where one of the links behaves as a rocker and the other as a crank.
- **test_case_16**: Tests the scenario where $T_1 > 0$, $T_2 < 0$, and $T_3 = 0$, leading to a π-rocker for the input and a crank for the output.
- **test_case_25**: Verifies that for $T_1 > 0$, $T_2 < 0$, and $T_3 < 0$, the input link is classified as a rocker and the output as a crank.
- **test_case_26**: Tests the scenario where $T_1 = 0$, $T_2 < 0$, and $T_3 < 0$, leading to a 0-rocker for the input and a crank for the output.

Special Intermediate Classifications

These cases cover intermediate classifications like π-rocker and 0-rocker for both input and output links.
- **test_case_2**: Tests the scenario where $T_1 = 0$, $T_2 > 0$, and $T_3 > 0$. The input is classified as a crank and the output as a π-rocker.
- **test_case_19**: Verifies that for $T_1 > 0$, $T_2 > 0$, and $T_3 < 0$, the input is classified as a 0-rocker and the output as a π-rocker.
- **test_case_20**: Tests the scenario where $T_1 = 0$, $T_2 > 0$, and $T_3 < 0$, resulting in a 0-rocker input and π-rocker output.

Other Rocker-Crank Configurations

These cases further verify various rocker-crank combinations for input and output links.
- **test_case_22**: Tests the scenario where $T_1 > 0$, $T_2 = 0$, and $T_3 < 0$, leading to a 0-rocker input and a crank output.
- **test_case_23**: Verifies that for $T_1 = 0$, $T_2 = 0$, and $T_3 < 0$, the input and output are classified as 0-rocker and crank, respectively.