Steering Calculation Tool

1. Introduction

The Rack and Pinion steering geometry is shown below:

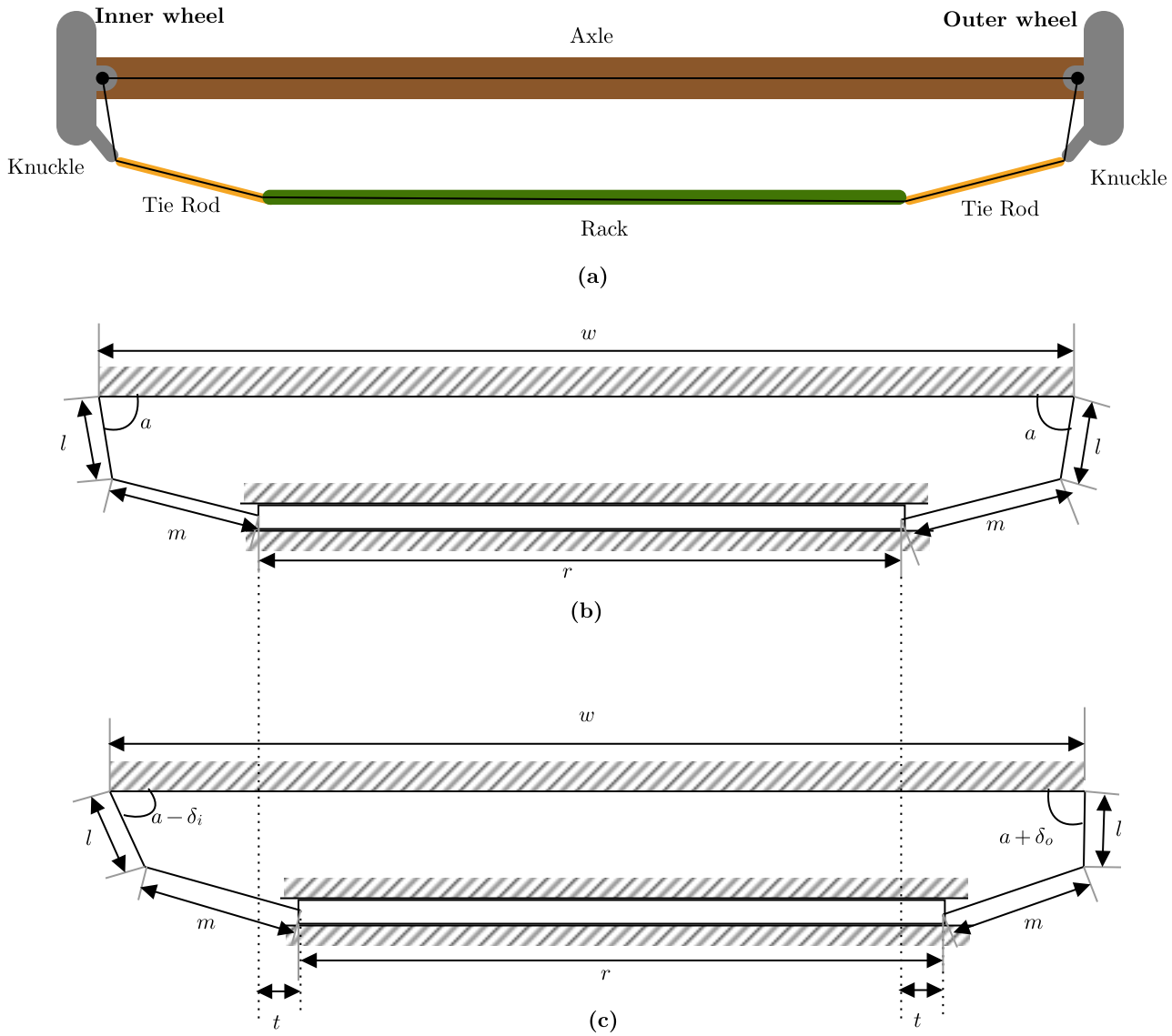

Fig. 1. (a) Illustration of the rack and pinion steering mechanism. (b) The mechanism when the vechile travels straight. (c) The mechanism when the vehicle turns left. The inner wheel turns through an angle δ_i, the outer wheel through δ_o and the rack shifts by t.

2. Using the Code

Run the code and enter the following information in degreed (for angles) or mm (for lengths) when asked for:
(1) The initial inclination of link of length l given by a.
(2) The maximum value of the inner turning angle expected.
(3) The distance between two knuckle pins (that pivot the knuckle with the axle).
(4) The wheelbase.
(5) The distance between the two ball joints at the ends of the rack.
(6) The maximum distance the rack can travel in either directions starting from it's mean position.

The code will calculate:
(1) The length l.
(2) The distance bewteen the two ball joints at the ends of a tie-rod.

(3) The distance between the axle and the rack.

The code will plot inner turning angle vs outer turning angle for
(1) An ideal steering mechanism that satisfies the ackerman condition.
(2) The said rack and pinion steering mechanism.

For the above calculation, the code solves equations assuming that:
(1) The ackerman condition is satisfied when the vehicle travels straight, i.e. $\delta_i = \delta_o = 0$.
(2) The ackerman condition is satisfied when the inner wheel turns by the maximum value (supplied by the user).
(3) When the inner wheel takes the maximum possible turn, the rack has travelled the maximim possible distance.

The output will end printing either "This mechanism can be used" or "This mechanism cannot be used". A condition beyond which no further turning is possible is depicted below. If this condition is reached when or before the inner wheel turns through the maximum possible angle, the code prints "This mechanism cannot be used". Else, the output says "This mechanism can be used"

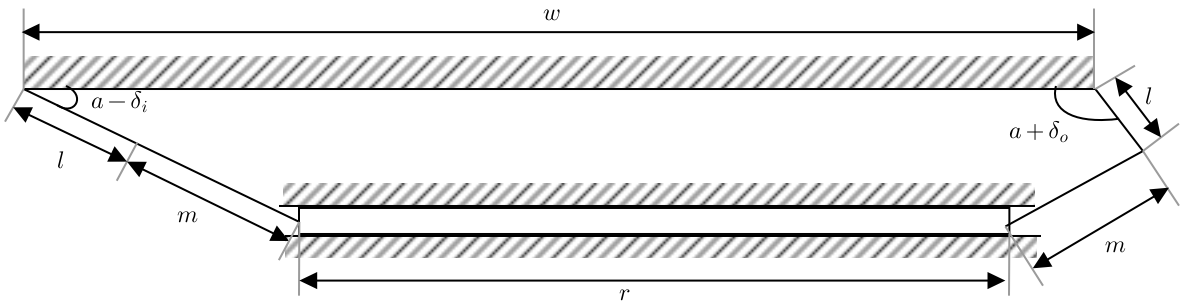

Fig 2. A tricky situation where the two links, of length l and m become paralles (see the left side above). No further turning is possible.