

May 21, 1987 - 1. (WO1987002951) SELF STABILIZING CAMBERING VEHICLE .. Inventor: JAMES, Phillip, Ronald . This is an active Pdf document. Click on the image to manipulate it and also use the various views to assist the description that follows. Consult the patent application for more information.

To make a right turn the driver turns his control [green] right in a smooth simple steer input. However, his input path is reversed so the front wheels turn left. This occurs via the steer rod [black] within the parallelogram [grey] and is due to the fact that the pitman arm [green] faces fwd but the left wheel steer arm [red] faces rearwards .

The two front wheels are maintained in steer alignment by a track rod.[white]

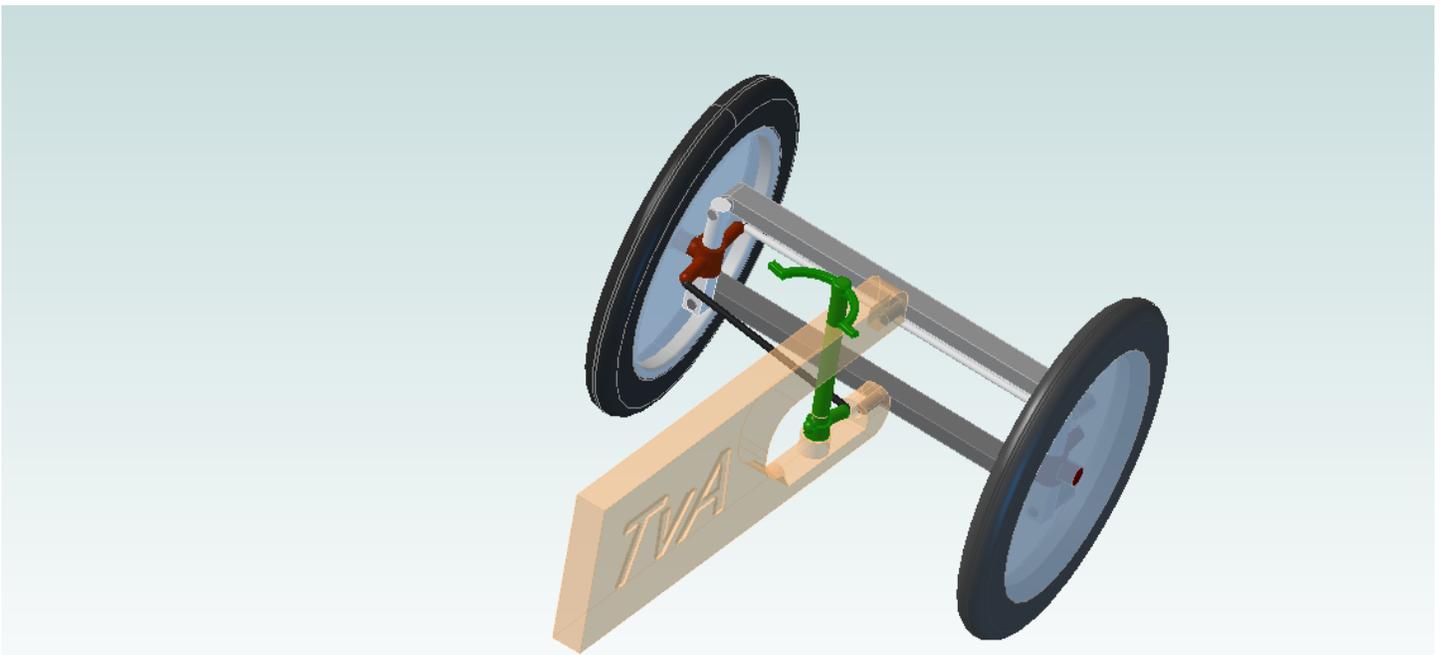
As soon as the front wheels move in a steered direction left the vehicle dynamically identifies this as " vehicle countersteer" and so the vehicle will tilt to the right due to centrifugal force. However, as soon as the vehicle begins its tilt to the right the wheels are automatically steered to the right[independent of driver input]. This occurs because the black steer rod is set at an inclined attitude within the parallelogram and any vehicle tilt will cause steer in the direction of vehicle tilt because the steer arm travels further than the pitman arm during any tilt action. So although the drivers right input steers the wheels left, the result is a tilt and a steer to the right. This results in a new stable steady state in the same vehicle steered direction as the drivers input direction and with a rate of turning relative to the driver's input displacement on the control.

Examine the dynamics of the steady state straight and vertical:

The driver is positioning the control to the center. If the vehicle tends to fall to either side this creates mechanically induced steer in the direction of the fall which forces the vehicle back to the vertical condition independent of the driver's input. These actions are not observable by the driver. When the driver wants a different steady state he makes an input and the balance equation is shifted and creates a new vehicle self stabilizing steady state. In this way the dynamics of a motorcycle are retained but the driver does not balance the vehicle and he steers exactly as in a motorcar.

The mechanism can be defined as a " differential linkage" It can also be defined as a " mechanical computer powered by inertia"

And so, no actuators or any other form of tilt force [except inertia] is required to create a simple steer motorcycle. This is only possible because there are laterally spaced wheels which can sense the road surface.[click the image to manipulate it]



The first action required in any motorcycle is a countersteer ie the front wheel/s steer in a direction opposite to the intended steered direction of travel of the vehicle. In a conventional motorcycle the driver is in the balancing loop of the vehicle and he MUST restrain / direct the control bar in a resilient manner and apply and withdraw countersteer torque to the bar to unbalance the vehicle and allow it to re-balance itself. The 1984 vehicle patent application[1987] was the first description of " automatic countersteer" .In the 1984 vehicle, the driver can position the control as in a motorcar and he applies a simple torque to turn the control to a new position.

Important points [1] the reversed input path [2] the inclined steer rod.

Be aware of the difference between the engineering terms [a] restrain [b] direct [c] position. To "restrain and direct" are resilient actions but on the other hand to "position" means to fix in place.

A conventional motorcycle requires skill to control because the rider must steer counter- intuitively in the opposite direction to his intended direction of travel which requirement in an emergency causes underlying confusion and can result in a mental block. The rider of the conventional motorcycle also must NOT position the bars or the vehicle will fall over. If the rider "freezes on the bars" he destroys the underlying stability of the vehicle.

The 1984 vehicle removed all of the flaws found in conventional motorcycles but retained all of the desirable dynamics associated with the type by making the drivers input identical to a motorcar.

This system has nothing to do with my later systems that employ FTC. see www.tiltingvehicle.net

Phillip James 11/6/ 2015