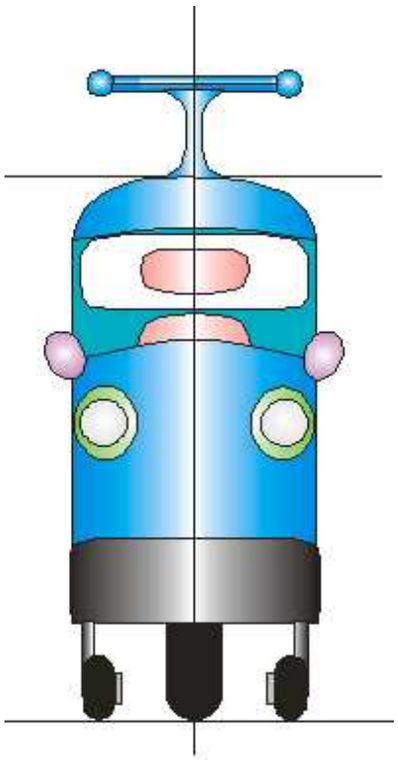
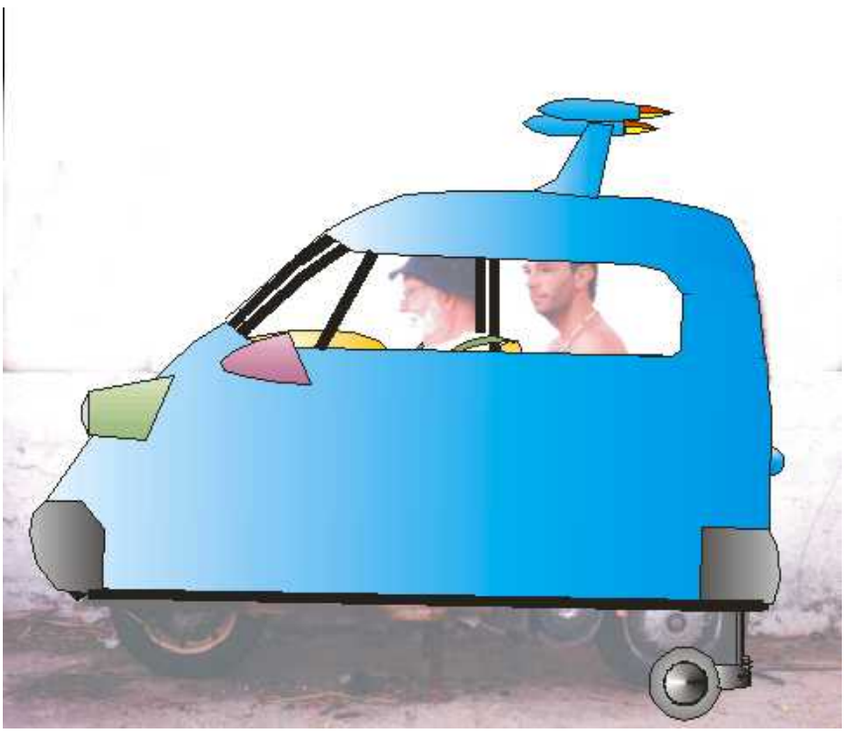
TILTER FROM A LAMBRETTA-200

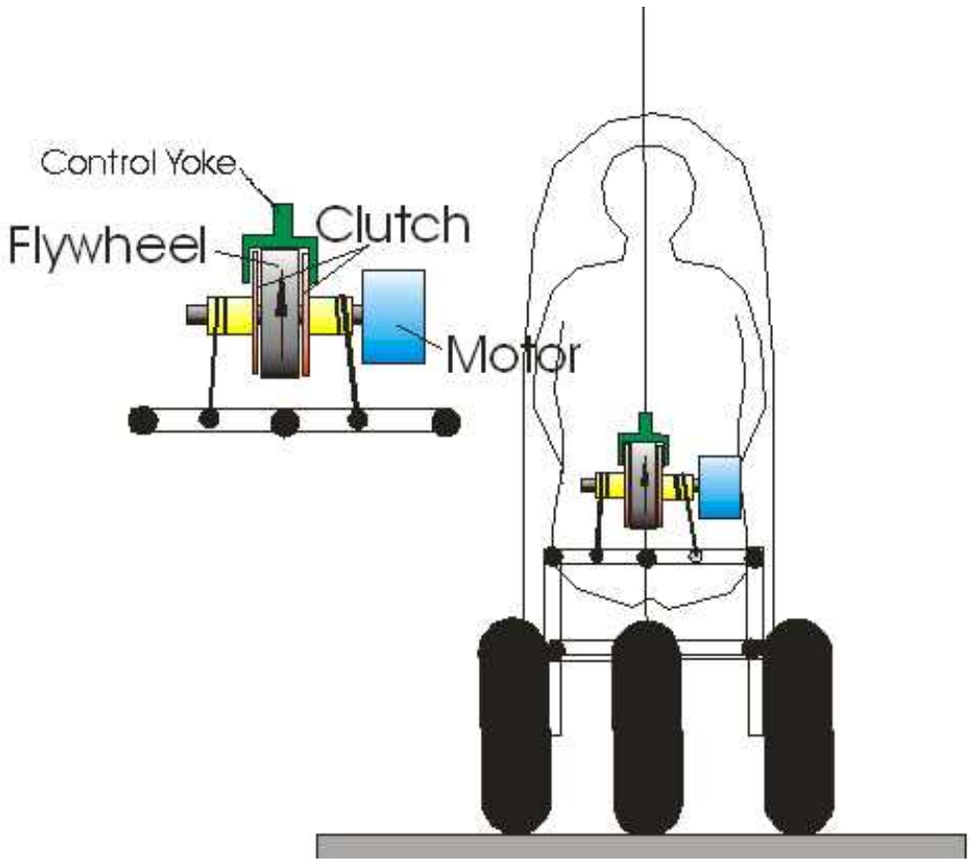




Here I show a project that I began some years ago and that has not advanced too much.
In the first picture you can see a Lambretta 200 in perfect running condition. Unlike the Vespa, this one has an extremely strong chassis and everything is attached to this chassis.
So you can leave it completely naked and is still fully operative.
The only thing that is missing is the handlebar, that cannot be used here.
A small front floor chassis has been added for a confortable seating possition
Complies to perfection with my points of view. It measures only 1.70 m of length, 0.67 m of TOTAL width and 1.30 m of height.
The comparison with The CARVER is incredible: 3.40 m lenght, 1.30 mTOTAL width and 1.40 height.
So the marvelous CARVER is like a Truck compared with mine.
Needless to explain that the driver comfort is perfect. It lacks a backrest, because I have not determined yet its exact design so that it does not hinder an eventual passenger. The driver goes as on horseback on a piece of foam rubber from the chest to the crotch.
Over said piece of foamrubber another is applied that extends sideways until hitting against the vehicle's body at both sides, leaving openings with sufficient space for the easy motions of legs and arms.
As this foam goes from side to side of the body it would be much more efficient in lateral crashes than the present airbags plus door reinforcing bars.
Later I have added a backrest after checking that it is not at all in the passenger's way.
The resistant rollcage needs a strong lateral bar, that would be a problem for accessibility. Therefore said bar goes in the vehicle's body. Later, after careful thinking I decided to install it in the rollcage, with some kind of opening mechanism, not shown,

that could be open even after a bad crash. I have now a good design for this failsafe mechanism.
The rollcage for the occupants is so small and convex that becomes extremely indeformable.
Therefore, aside from the foam rubber I have added a safety belt of four points for the driver (Not shown for the passenger) that would make it difficult for the occupants to be killed in the more catastrophic of the accidents, short of being run over by a truck.
Watch on TV the accidents that can be seen in American stock car or F1 races, that look like explosions from where the driver always comes off cleaning the dust off his clothes.
You enter and come out from this vehicle, opening the body as shown. The foam rubber does not hinder at all the necessary body motions. It is very similar to mounting a horse or a modern motorcycle.
You can see that the possition of the adult passenger if not perfect is acceptable but that there is still room for luggage.
With no passenger the storage room available is of about 500 liters
One must design some couplings for the body and the side bar that can be opened after an enormous collision, not as what happens with the doors of the present cars. As I said I have a good design for this.
Heating can be mounted easily enlarging a little the cylinder cooling fan and putting a heat exchanger at the style of the VW Bug, The situation of the exhaust pipe is excellent for this.
The essence of this vehicle is in the two lateral wheels, at the height of the rear wheel (For kinematic compliance) that are used only to perform equilibrium corrections.
The system has not yet been built. Here you have one of the first previous designs. They show two small side tilting wheels operated by a high speed flywheel and two clutches
The explanation on how said small side wheels are controlled

needs a long article.



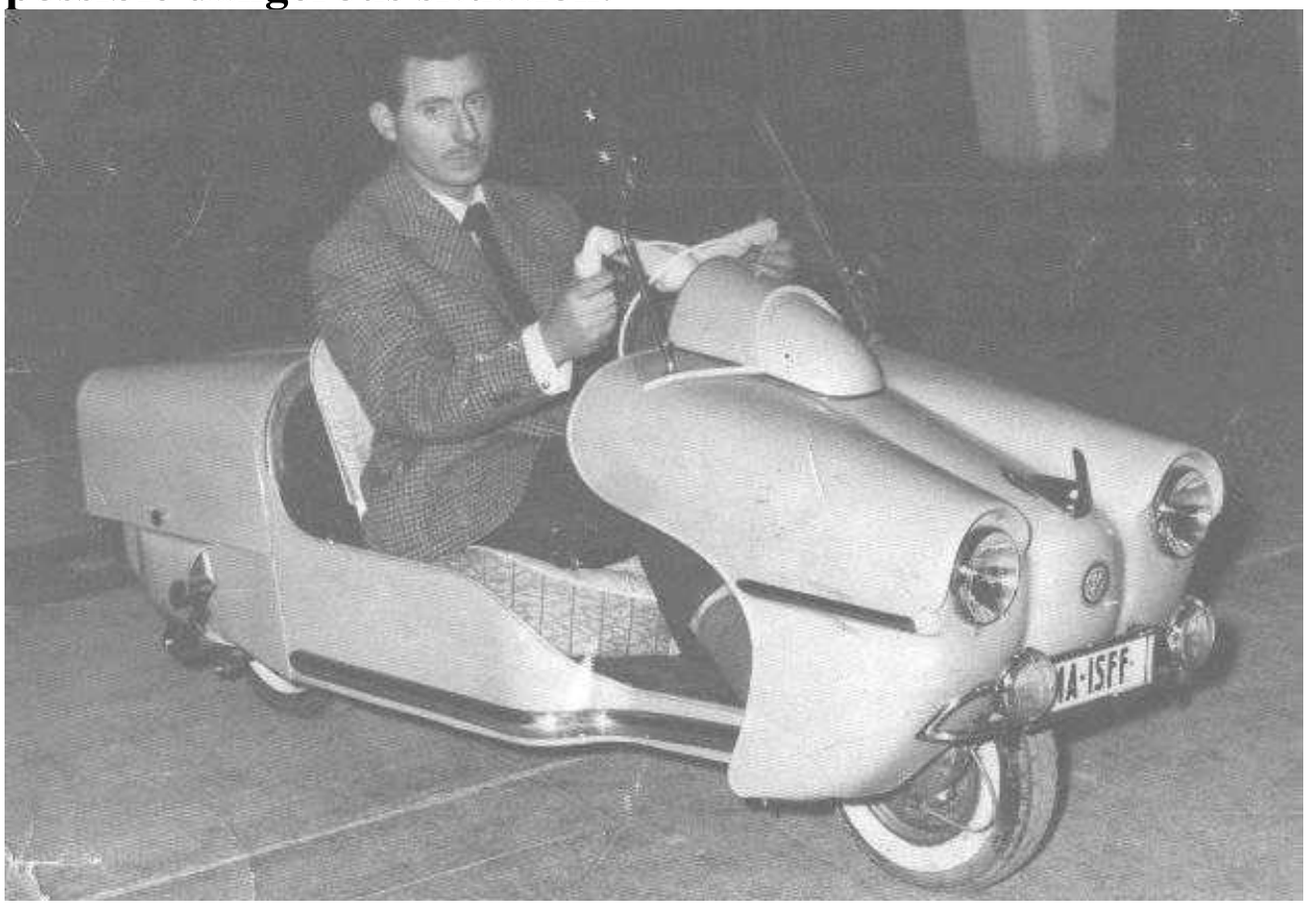
Here is a sketch showing an abridged explanation on how it works. It has two clutches, each one moving up one side of the leaning mechanism. This mechanism is based on the wonderful properties of the dynamic solid to solid friction that can apply any force to a mechanism but this mechanism cannot apply any extra force on the clutches.

I am not yet going to publish it completely before consulting to see if my theories are correct.
Melchor Duran
Aznalcollar Summer 2003

PART II- 2004

Since my begginings around 1950 in this Field I did not go for the TTW but for the T4W.
One front and three at the rear.
Mechanically they were equivalent to TTWs But the central back wheel carried the vehicle's weight, the traction and braking, being the side wheels, much smaller, for leaning control only.
Does it seem a stupid complication?
Not quite. Just after WW2 the Italians had designed two wonderfull scooters. The Vespa from which I made my first really good prototype and the Lambretta from which I am planning to do my last proto, more than 50 years later.
The reason is very simple: Most of the Tilter is already complete from the factory to be used with minor changes. This made a lot of sense!
The addition of the two tilting side wheels and the tilting mechanism is in most designs simple and unexpensive to be made in a garage workshop,
And the result is about the same or maybe better than two Calleja type rear wheels. The tilting power can be taken from a small electric motor or directly from the rear wheel or the engine's transmission, as I am planning to do for my "80 Km/h Wheelchair for the Crippled".
I usuallly do a lot of practical research in all my prototypes. mostly on ergonomics.
In he Vespa Prototype the side wheels were actuated through strong springs directly from foot pedals. In the elongated sitting possition you could put a lot of leaning or upturning force in

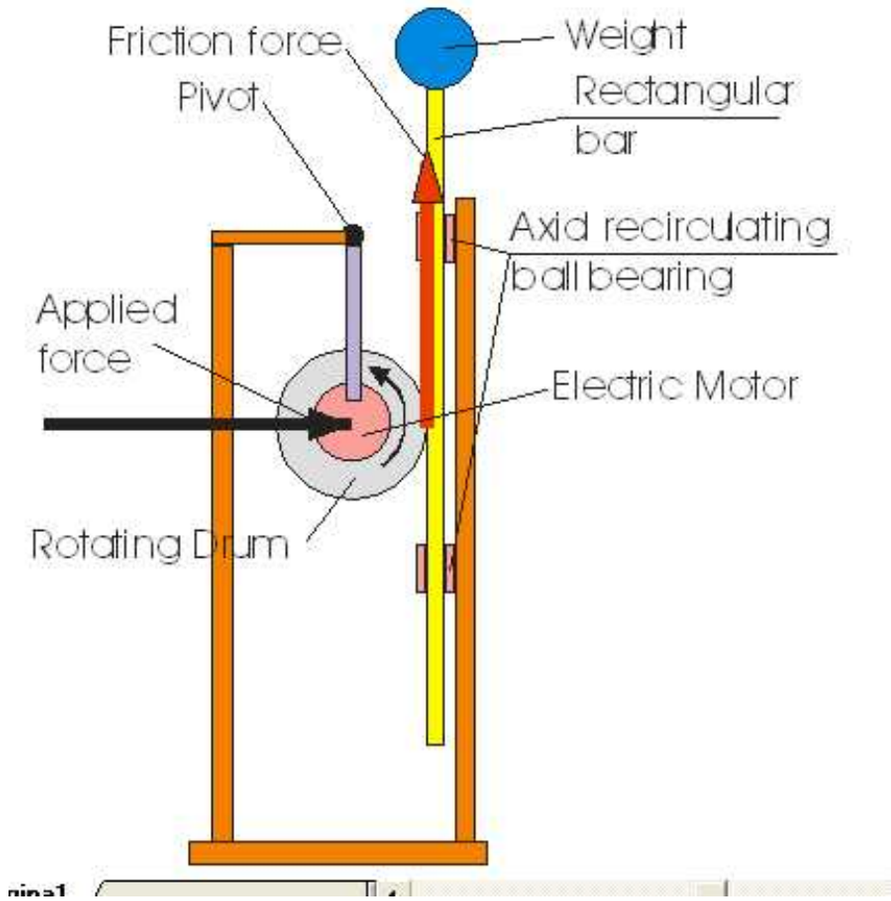
these wheels when needed.
In driving practice the driver had the feet loose on the pedals and the springs kept the side wheels high inside the body.
This is the reason why they cannot be seen in the only picture left of this prototype that ran many thousands of Kilometers on the then bad roads of Spain .
They were used only when the driver decided that there was any possible dangerous situation.



At first the side wheels were hanging loose all the time on the pavement.
But they made some unnecesary noise plus they had some small but also unnecessary drag.
So the final solution was to have the feet always resting on the pedals and the wheels up. The driver reacions were always fast enough.
With this innocent looking tilter I won (Illegally) a beach race between pylons against the fastests Bikes of these times, Bultaco

and Montesa.
My top speed was pityful but my turns in the pylons were marvelous with the help of the outboard side wheel.
Most people would consider that a width of only 0.67 m is ludicrous.
but I chose it because it seemed natural for the existing chassis.
Later I made one wiremesh body for the Lambretta hinged at the front and checked myself, a rather fat and heavy shouldered old man, as you can see in the pictures, for ergonomy.
Everything seemed OK. But I still recognize that they may appear psychological negative reactions. Normal guys are strange people!
I have measured my own Renault car interior wall to wall distance and happens to be 1.31 m: That is 0.75 m for each person.
And in the high performance cars like Porsches and Ferraris the thing is even worse with their enveloping bucket seats.
The ultimate example is the case of the Fighter Aircraft pilot, where the designers take extreme care to have the pilot relaxed. But he/she cannot practically move.
Another extremely interesting example of why you do not need to move at all while driving is the motorcycle.
The pilot gets "Glued" to the fuel tank, elbows inwards, and he moves hands and feet for a few centimeters only and only ocasionally for hundreds of Kilometers.
This IS a real torment. But nobody complains.
I made several 500 Km trips in my Vespa Proto and ended less tired than if I had used a large car. The main reason, I believe is that in a Tilter there are NO lateral accelerations on your body. sometimes of great magnitude in cars.
Its effect on he brain is the probable reason for getting "Travel Sick".
I believe that nobody has mentioned this VERY important fact in favor of TTWs.

I have recently mentioned to Mitch Casto that it would be a good idea to design a TTW to try to win the Paris-Dakar rally, in all the categories.
A victory there would be the last push the TTWs need.
Is it possible?
I believe that we can try.
(Caution: Do not try with CARVER type TTWs)
First, I beg the pardon of all the good Mechanics and Engineers who may read this for reexplaining the Laws of Solid Dry Friction.
But as I never believe in the real life results of some Laws of Physics because usually there are too many not controlled parameters, let me show the experiment I did.



The drawing is selfexplanatory.
Applying a force to the rotating drum and incresing it until the friction force that appears in the yellow bar balances exactlly the weight on top, the bar and weight seem to float in space.
You can move it up and down using negligile forces.
And at very high speeds too. The limit being the rotational speed of the drum. So it should be as high as necessary.
This is the lousiest system one could imagine to keep a weight up. It dissipates a lot of energy.

But we are not going to do that. We'll keep the weight (Vehicle) by another usual means as levers and springs and we'll use this system to move one wheel up and down very fast and only occasionally for tilt control.
We would apply sometimes very strong and well controlled forces but in fractions of a second only.
So the average energy dissipation would be rather small
Let us assume that we have very narrow TTWs using this tilt control
The sketches shown are not at all practicable designs and they are for explanatory purposes only.

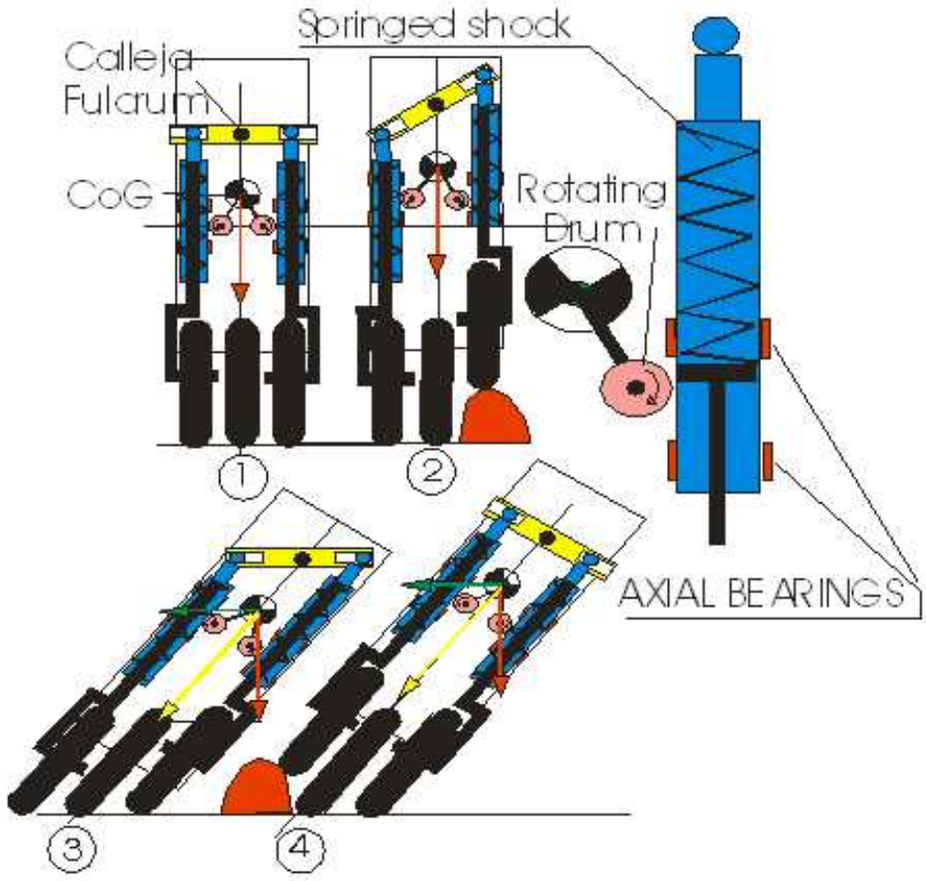


Fig (1) shows a TTW running in straight line. As the system is of natural lean with occasinal corrections, it goes suspended to a Calleja fulcrum via standard springed shock absorbers. The rotating drums are not applied.
So the operation is exactly that of a Motorcycle.

It cannot be kept up except by a continuous use of countersteering so as the traces of the wheels on the pavement are snakelike.
The higher the pavement friction the straighter the snakes can be.

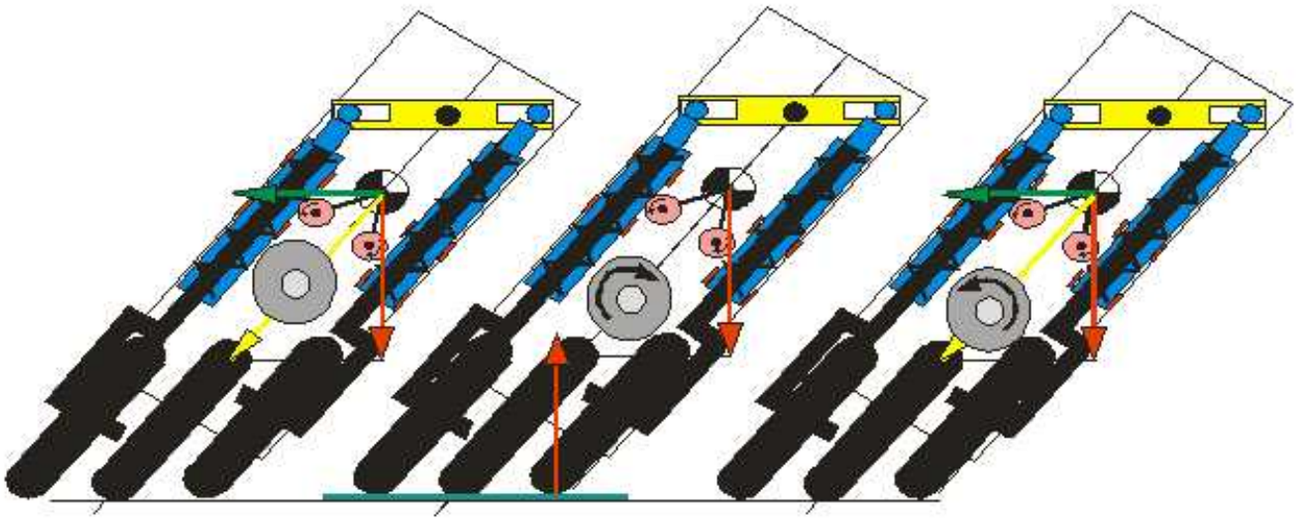
But in bad pavements like plaques of ice or dune sand the snakes can become so bad as to make you fall. Simply watch the videos of the Paris-Dakar motorcyclists in deep sand. Poor guys!
In Spain, many years ago, roads were built by spraying very fine gravel over hot asphalt as a finish layer. During years you suddenly found murderous patches of this fine gravel. All the good drivers knew that the only way to pass them was by freezing the handle bar and pass as a solid body. Naturaly if you got through you had to use later some heavy contersteering to straighten up.
With the system I propose, there is no need to counterster to keep the vehicle in equilibrium. To pass one of the gravel patches or sand duneI have mentioned would be a child's play.
In nondangerous conditions you must use countersteer which is much more energy efficient.
But there are some other dangerous situations as shown in Fig (2) One side wheel encounters a large boulder or simply there is a sudden lateral warping of the road or path.
The commonly proposed Hydraulic Ram systems would really be nearly
USELESS, repeat USELESS. At high travel speeds their response is too slow, so they look from the vehicle's point of view as if they were solid.
The springed suspension helps, but everybody knows that even wide tracked vehicles overturn in these conditions.
With the new system there is no problem at all, even if at this precise moment the wheel is being forced up or down by the rotating drum.
In the Fig (3) and (4) you can see the same conditions but in a heavy curve.
In Fig (3) you may find sudden but small changes in road/ wheel friction that normally are corrected by coutersteeering except in extreme cases where you can use the friction drums instead in a much safer way.

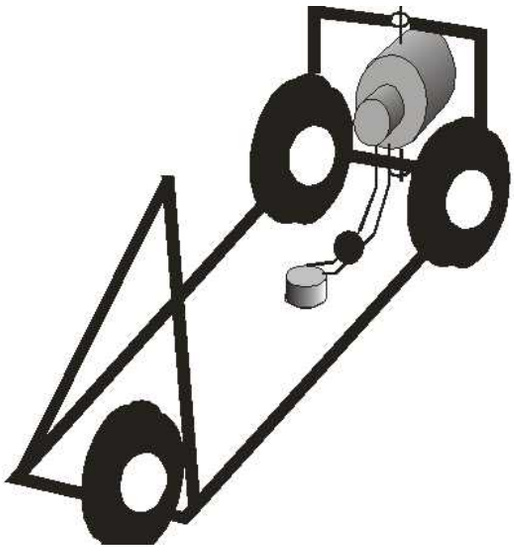
The encounters with boulders or sudden warps are dealt with in the same way than in straight line driving.
The worst case which is the sudden and large changes in wheel/ road friction, like when passing over an oil spill in a curve, with an extreme decrease, followed by a sudden extreme increase in said friction.
I feel too lazy to study it. I invite everybody to try.
Tony Foale, Al Fonda and many others Where are you?.
Unfortunately we are only three people in Spain. Calleja, a real innovator that has left the fight, I believe, Pitcab, probably a young student and myself who keep working nearly crippled.
It is a very complex case although very common.
I recognize that the Patenting System has helped a lot in the progress of Technology.
But in this case of TTWs I no longer believe in fighting for who invented what.
We should collaborate.
Now that I have an acceptable perspective of the direction of History, I can see that our beloved large cars would be unacceptable sooner than expected.
Let me say it in a Romantic old fashioned way: It is our Duty to invent the smallest, safest and more spartan vehicle we can.
That is: A good TTW.
And as everybody knows that innovations have some times enormous multiplying factors, our so called "Developed Countries" would be unrecognizable at the end of the XXI Century. but not in the way that most Sci-Fi writers tell us.
Either in a new Cave Age or with flying cars and all that crap.
We do not need a Doomsday but only to back up a little bit but without losing our quality of life. That's what good engineers are for!.
not just to blindly follow the trends of the Large Multinationals, that historically have shown to have been wrong many times.
Remember the heroic fight of the aviation pioneers, like Lindberg

and some forgotten Spaniards against the gigantic Shipping Companies with their Powerful Transatlantics. Who won?.
Keep working, please!.
And forget the foreseable fight to death by the Large Carmakers helped by the Governments!. This battle has not begun yet because we are so small that they do not even see us.
If in the process you make Millions, Good!. But please do not sell your souls to the BIG ONES like the aviation guys did not, but start small Companies that would be the BIG ONES of the Future.
Good innovative ideas are always fouled up when they fall in the hands of the Transnationals.
Melchor Duran.

PART III 2004
Last night I slept better than usual and this morning I found a rather farfetched solution to the last problems of stability I talked about.
The TTW is taking a curve at maximum speed. Suddenly the driver finds a large oil spill (Green). The centripetal force dissapears practicaly, and so the centrifugal force. The the vehicle is subject to gravity and the reaction force in the inner wheel. It is easy to see that the vehicle will inevitably fall in.
We need a Miracle.
Maybe in the shape of a heavy, small Gyroscope provided with an enormously powerful accelerating torque motor.
I invented this motor many years ago for the robots of the Future (Its time has not come yet).
It can apply tremendous torques, finely controlled, in fractions of a second.
As soon as you have passed the oil spill (In fractions of seconds or so). the motor decelerates the Gyroscope to back to zero if the pavement is the same as before.
If not, ther'll be some residual speed in the Gyroscope.

This contraption could possibly work well when you hit a sidewalk or tall obstacle sideways.





As you can see, the Gyroscope case is mounted on a rotatable vertical axis, so as there is no influence on the steering.
Please notice that this is NOT a Gyroscopically balanced car.
On the contrary the gyroscopic forces are here a nuissance.
The rotating mass is used here just to produce a tilting torque when accelerated or decelerated.
In fact we could use a powered pendulum to perform the same effect.
Just as the driver does with his body for small corrections in the motorcycle tilting angle.
Maybe you could get rid of the frition suspension described before and use only the Gyroscope.
At the moment, I do not think so because the Gyroscope needs so much peak power that possibly it would be better to actuate it from a very high pressure small cylinder, CO2 maybe.
I woul like to get critical opinions
Thanks