FIRST CONCEPT OF LIFE TEST MACHINE FOR GROUP WHEEL - SUSPENSION

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Abstract

Pneumatics are the principal component with the which we can have the interaction between the ground and the vehicle. For better evaluate the behavior of pneumatic, wheel and suspension right now there are different procedure and different test machine we can find on bibliography and also on industrial field.

We have observed that all of these machine are focused on only one components, in particular we have wheel street test machine used to test pneumatic and also the stress transmitted on the wheel (sometimes). For the wheel testing there are different standard of testing, we have impact test, tire stiffness and footprint measurement machine, rolling resistance machine (ISO 28580), endurance test, etc. For suspension (and shock absorber kit) we have several equipements. The most reliable is again the test on a veichle where we can put DAQ and some sensors (accelerometer, strain gauge and potentiometer) but them can be done for a small period of time and also are very expensive. There are four poster rig where we can simulate a path of a car and repeat it n times and check the life time of each component. This can help especially for fatigue analysis and also the see if some load case are not took in account during the design phase.

Our aim whit this work is to define a new standard machine that can be set for make this kind of test.
For doing this we tried to study what the designer need and what testing engineer what to investigate. Starting from this questions and comparing them with the testing machine we can find on the market we tried to think to a concept of a machine that can offer the possibility to be configured in different way and to make different test. The machine is studied to mount the full suspension on a rigid table. This rigid table can move up and down and is moved pneumatically by an actuator that have to be very fast (not least than 1k Hz). We also have a strong basement where we have to put attention on a modal analysis because of natural frequencies can affect the data acquisition and we need that the natural frequencies of the structure are far from the range where we expect to work (0-20/30 Hz).

The machine have also a table (hexapod table for the first study) where we put a conveyor moved from an electric motor, so we can also simulate the slip angle by moving the table and the rolling of the tire. To transmit the force to the tire at the first concept of the machine we can use the movement of the suspension on the table but, we want to add for the next study an additional actuator that can help us to simulate the load transfer for example on curve phase or in braking phase.
At the end last consideration this machine have for sure to have a strong and flexible mechanic but need to have a efficient software for move the different actuator and also for acquire data, so we will have to choose the right hardware, proper (fast) for our aim.
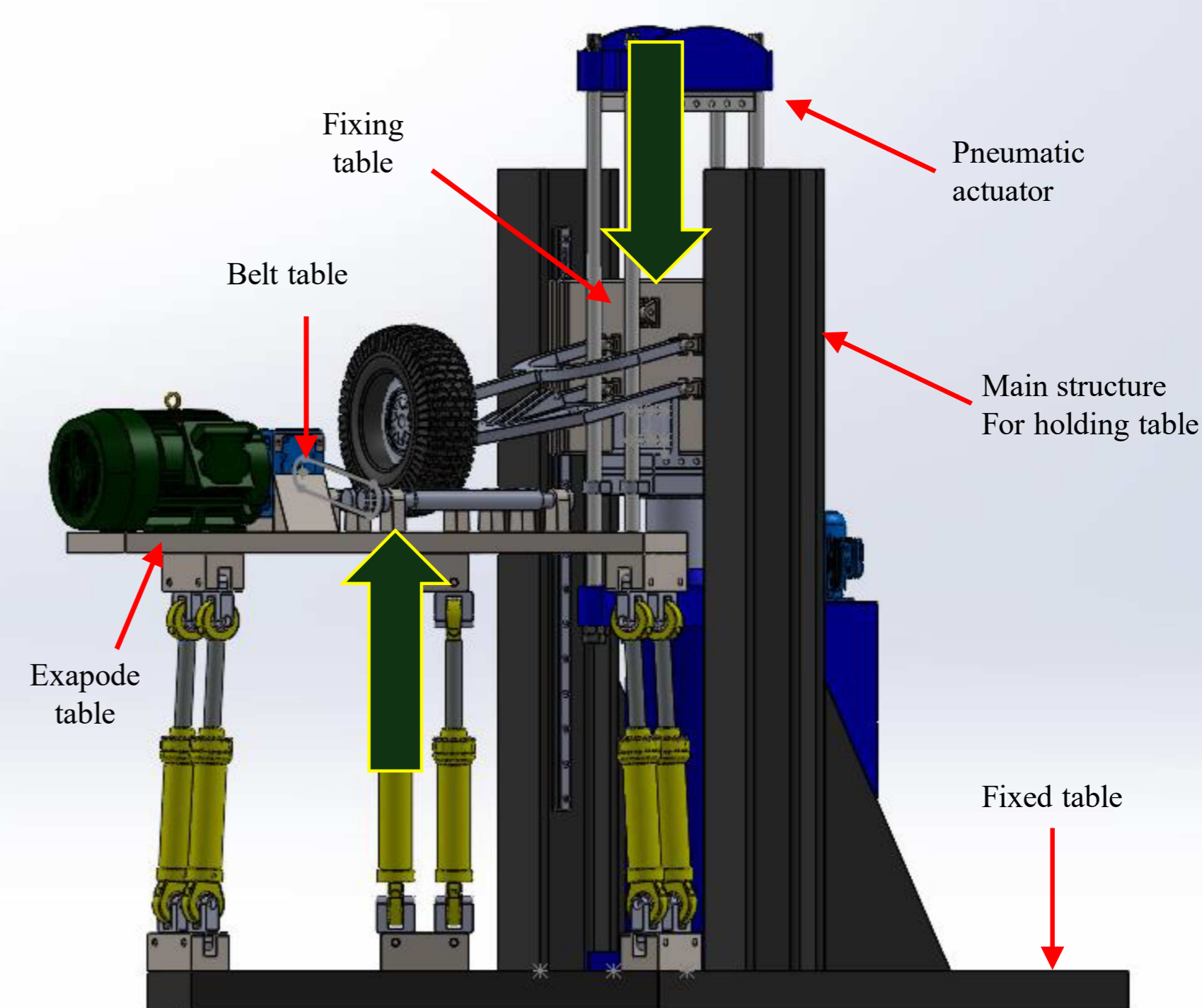
Concept

Figure 1. Main gropu of the testing machine

Design phase (hints)

The first step to project a new machine starting from a white paper is to define a first concept and then start a discussion on it, checking the weakness and studding the addition to improve it. So as we can see from the previous picture we have at this stage a first proportioning of the machine by rough calculus and the freq. analysis (first 4th Natural freq. 30.5 32.1 38.7 41.7 Hz).
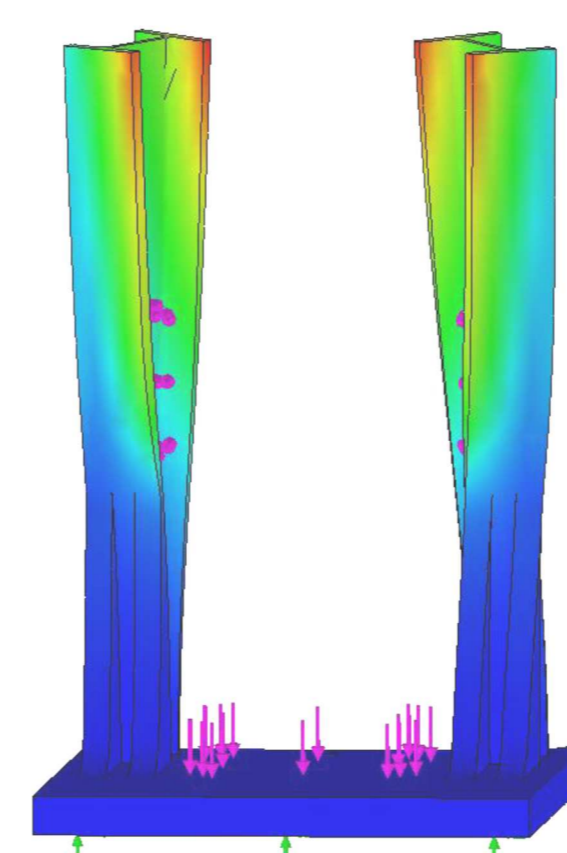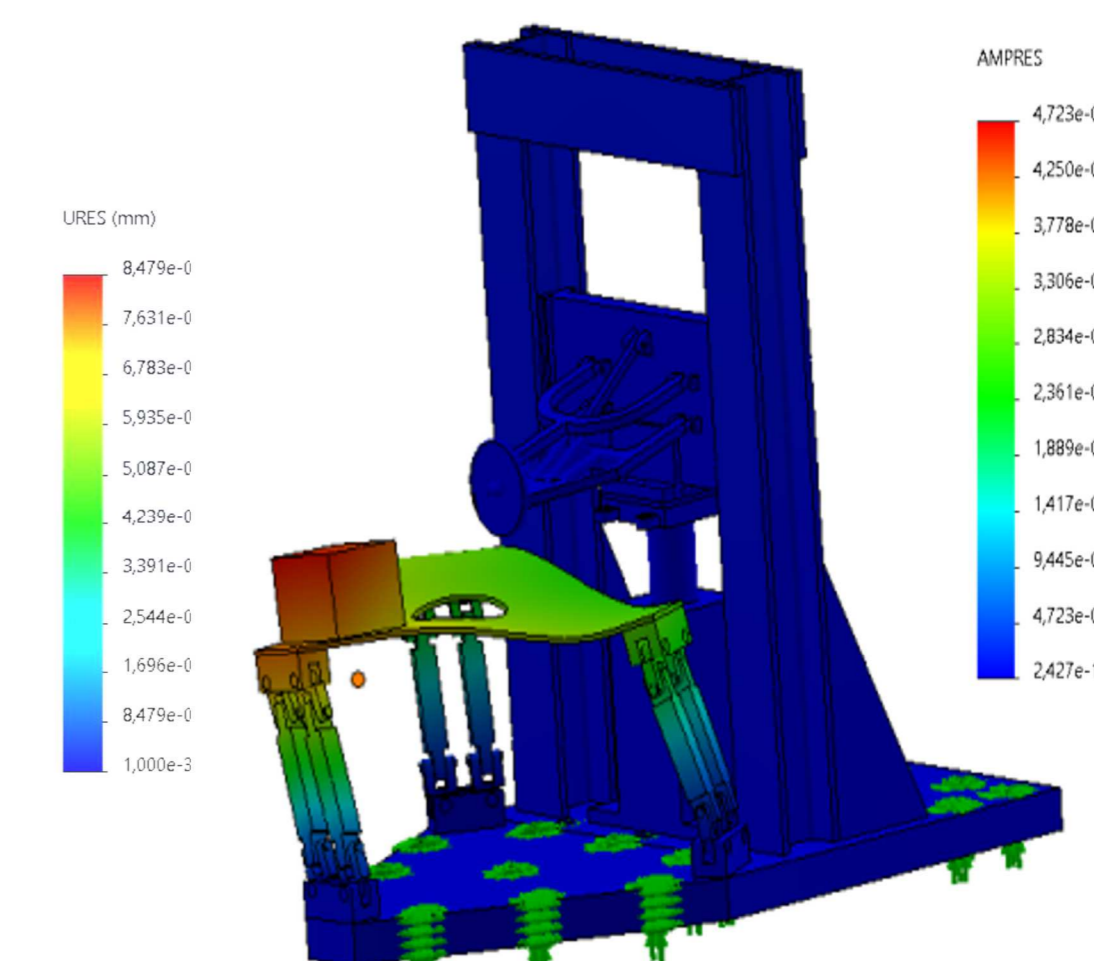

Figure 2. FEM Study of the coloumn   Figure 3. Modal analysis

Conclusions

The present research reports the main results in order to design a new concept of testing machine for life and fatigue test of the group suspension, wheel and tire. It was done starting from the analysis of the state of the art and then we studied a combination of the different test that can be made and we had defined a possible layout (first study). Starting from this first layout me made a desing by 3D modelling and FEM analysis. This machine can help to avoid to make big test campaigns on field but starting from data repat them on the machine with DAQ and with high level or repetitiveness. The reserch is still in progress to complete and adding more feature to the machine and to go in deep in some possible simplification that can make more easy the software programming.