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## THE CONCEPT OF A RESEARCH VEHICLE CHASSIS BASED ON A MARTIAN ROVER

**Abstract:** Modelling of complex technical objects such as Mars rovers requires vast knowledge and the ability to use specific design tools. Here are the three main analysis presented used to check the correctness of the technical measure. These are: strength analysis, analysis of air flow and motion animation.

### 1. Introduction

The growing population of people on Earth, with more and more limited area to the population leads us to look for new places where life would be possible. One such possibility is to look for conditions conducive to life on neighboring planets, such as Mars.

Thanks to advances in science and technology has increased the possibility of constructing new facilities and technical design. Examples of such objects are, inter alia, space rovers that are used in the tests of surface and climate of Mars.

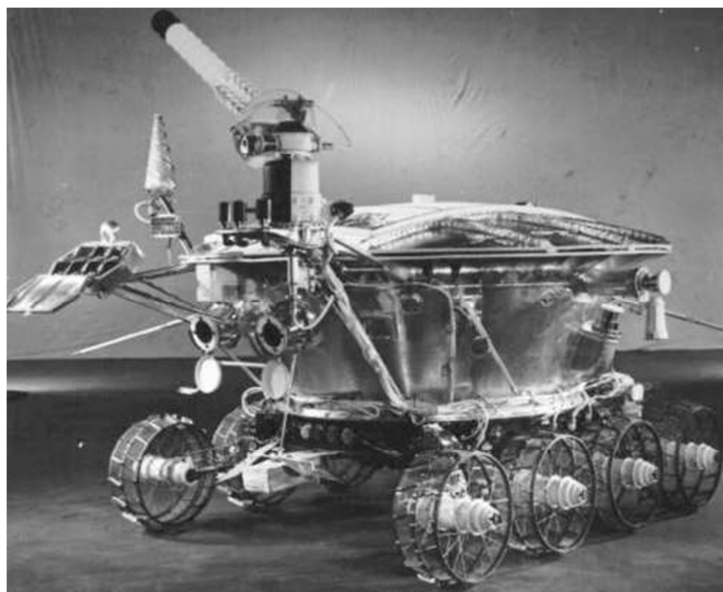
A computer with adequate processing power and the right software is an indispensable tool builder today, without which it would be possible to make complex calculations or analyzes.

The paper presents the optimization process in the Martian rover CAD - Computer Aided Design. The optimization process was made after review of the history associated with the transfer of research vehicles in space and in the depths of the sea.

### 2. The concepts used to build the rover

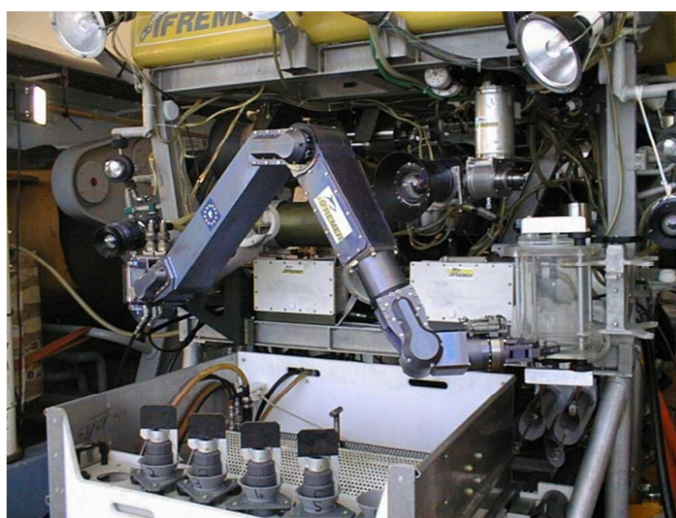
To properly model the Martian rover body should analyze existing solutions. These include all the missions to be performed in order to investigate, penetrate the planet Mars and the Moon.

One such mission, and also the first successful, was the 17th mission of the Luna It was the unmanned Soviet spacecraft mission to study the moon. Luna 17 delivered to the lunar surface remotely operated vehicle Lunokhod 1 - the first such foreign lander on the planet (Fig.2.1). [1].



*Fig.2.1.Lunochod 1 Rover[1]*

Further patterns that have been used in the design were the missions involving the study of the deep seas and oceans. One of these patterns may be French underwater robot Victor 6000 (Figure 2.2), which is used for scientific research and exploration operations carried out in deep ocean waters.



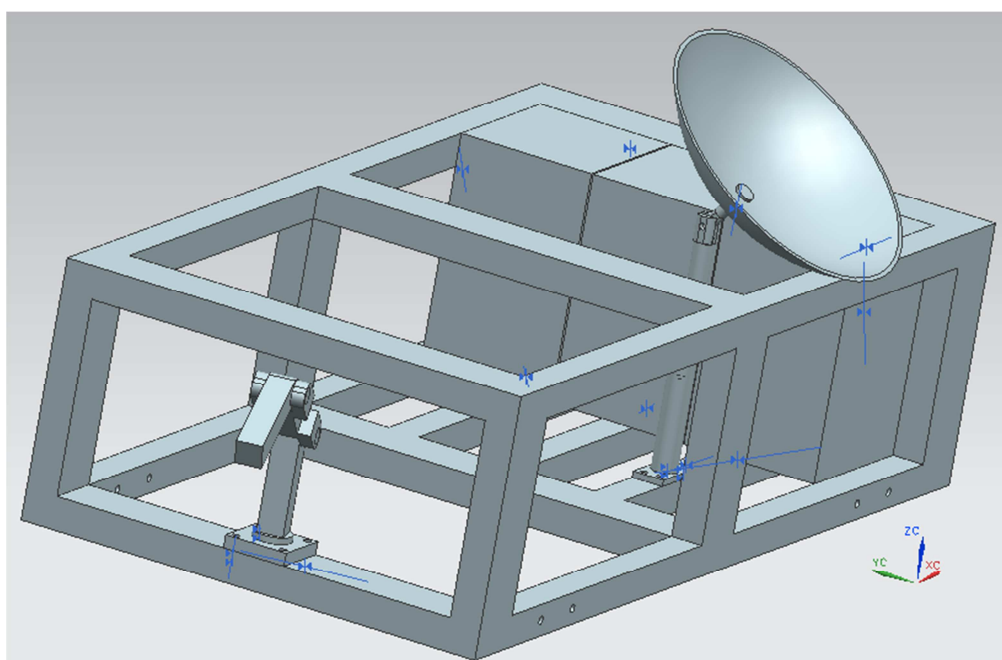
*Fig.2.2 Victor 6000 underwater robot [2]*

Victor 6000 can dive up to a depth of 6000 m, has 8 cameras, 8 searchlights, and two remotely controlled robotic arms with the joystick, from the deck of the ship. The robot weighs 4 tons.

### **3. Mars rover body design**

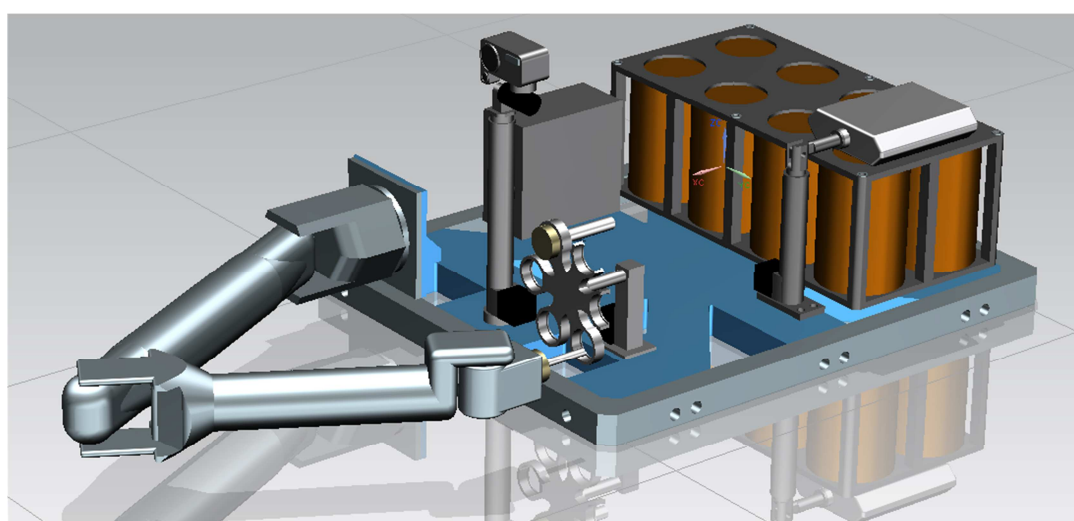
Attempts to make a Martian rover's body took place in parallel with the emergence of more and more new component of it. It was a process of necessary and very important from the

perspective of creating an advanced mechanical system which is the Mars rover. It allowed the planned arrangement of the components, their appearance, shape, size, and weight. The initial deposit is shown in Figure 3.1, which has approved the deployment of the batteries, and pointed to the wrong shape long antenna gain. Changed the position of the manipulator, as it prevented the arrangement to his full advantage of the work area so that might have had to be moved to one of the front side of the base.



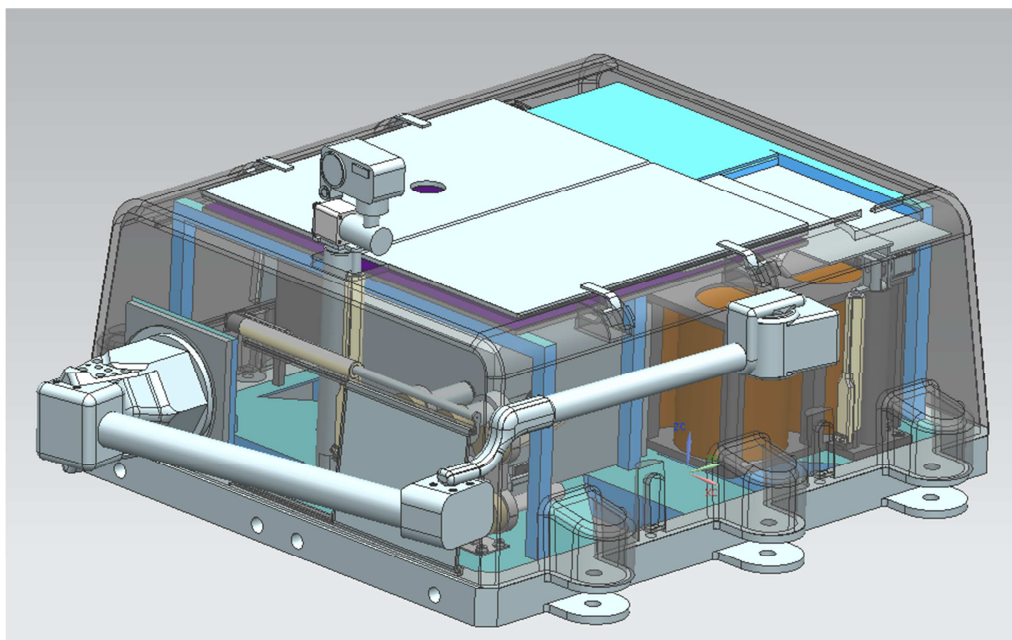
*Fig.3.1 Initial submission of the body*

Significant modification was also the basis, because it has been shortened by 700mm, almost half the length of its initial release. Deprived of the upper part, it means the vertical supports and horizontal stabilizers.



*Fig.3.2 Next submission of the body*

Another submission body (Fig.3.2) shows that have been made to change the appearance, shape or arrangement of individual components. Were added another model teams included in the jeep. It allowed confirm or dispel doubts about further construction and arrangement of the components. Mass manipulator tool with a socket and a camera placed in front of the balancing weight at the rear of the battery. Creates a free space in the middle of the base. Therefore, in order to exclude a waste of space, the place is made every spontaneous research centre, which will also reduce the storage of the sample, which will not have to collect as much as was originally planned.



*Fig. 3.3 Submission of a whole body rover*

Figure 3.3 shows the whole body, including Mars rover housing protects components inside the rover.

All components included in the Mars rover's body, along with washers, screws, screws, nuts and motorized weighs 125 kg.

#### **4. Strength and air flow analysis**

Stress analysis process presented keypad module MCS NASTRAN, process optimization has enabled accurate object tested. However, the study of air flow in the module FLOW / THERMAL, components such as antenna, camera and housing, shows the distribution of pressure that may occur as a result of the atmosphere of Mars.

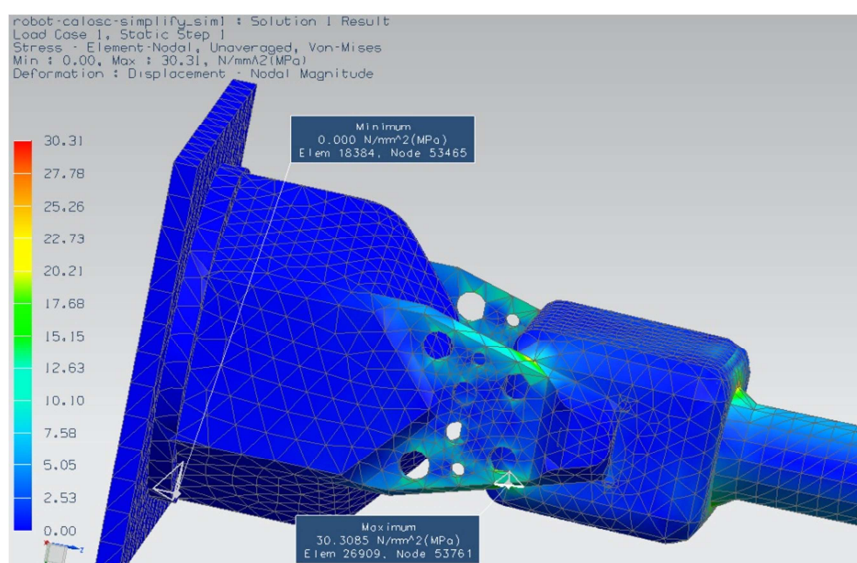


Fig. 4.1 Stress analysis of the manipulator submission

The analysis presented in Figure 4.1. illustrates the final result of the optimization process in the assembly manipulator. It was conducted in reference to the four principles J.Dietrycha: optimal load conditions, the optimal base material, optimal stability and optimal relations associated quantities. Strength analysis is based on the principle of optimal load condition, which assumes the maximum number of security equal to 10. When deployed the material, which is a strength duralumin of up to 300MPa, it can be concluded that the optimization was carried out successfully.

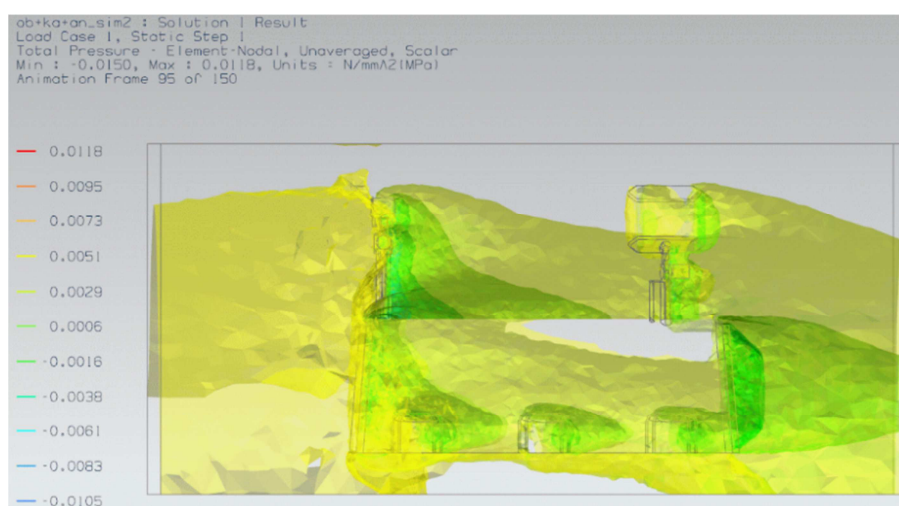


Fig. 4.2 The results of the FLOW analysis

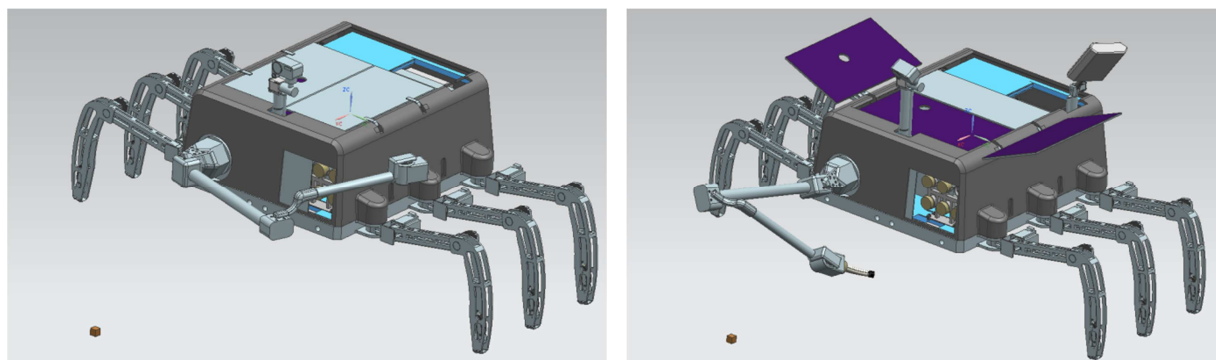
Flow analysis was carried out for the antenna and camera, which are exposed to the pressure generated by the flow of air through the enclosure is placed over the line. These pressures are caused by high speed winds present on the surface of Mars, reaching up to 300 km / h. An analysis of the housing deposit to the antenna and the camera (Figure 4.2), which is designed to check the pressure on the existing housing (high blood pressure) is greater than



the pressure beneath it (vacuum), which is responsible for the proper pressure the rover to the ground.

## 5. Motion animation

Motion animation was made for all the active elements in the Martian rover Body Motion Simulation module.



*Fig.5.1 Stages of the animation next working rover*

Figure 5.1 shows the successive stages of the Martian rover motion during sampling. This step allows you to verify that all components of the rover's work together and if there is no motion during a collision. It also allows to set the order of these components, so that they do not interfere with each other.

## 6. Conclusion

The creation of the Martian rover body model using graphical software Unigraphics 7.5 allowed for the accurate knowledge. In this way it was possible to perform stress analysis, flow analysis, and a motion tween.

Stress analysis was preceded by a process of optimizing all the components of the body. This analysis verified the correctness of optimization and allows the conclusion that the items were well chosen and satisfy the principle of optimal load conditions. Optimization also made it possible to reduce significantly the weight of the vehicle, so that the cost of sending significantly decreased.

Proved to be the most labor-intensive analysis of the airflow through which we can say that the cabinet has been designed properly and pressure that occur when the air flow is maintained and the case meets the principle of optimal stability.

Motion animation shows that all the devices interact with each other in the absence of conflicts of the entire system.

## References

1. [http://pl.wikipedia.org/wiki/Łunochod\\_1](http://pl.wikipedia.org/wiki/Łunochod_1)
2. <http://www.asimo.pl/modele/victor6000-robot-podwodny.php>