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

**Abstract:** In this paper is presented the design process of the research vehicle chassis made entirely by a computer. Analysed using the concepts of knowledge in the field of bionics. A model, stress analysis and aerodynamic optimization and traffic simulations. To complete the model and analysis program was used Unigraphics NX 7.5.

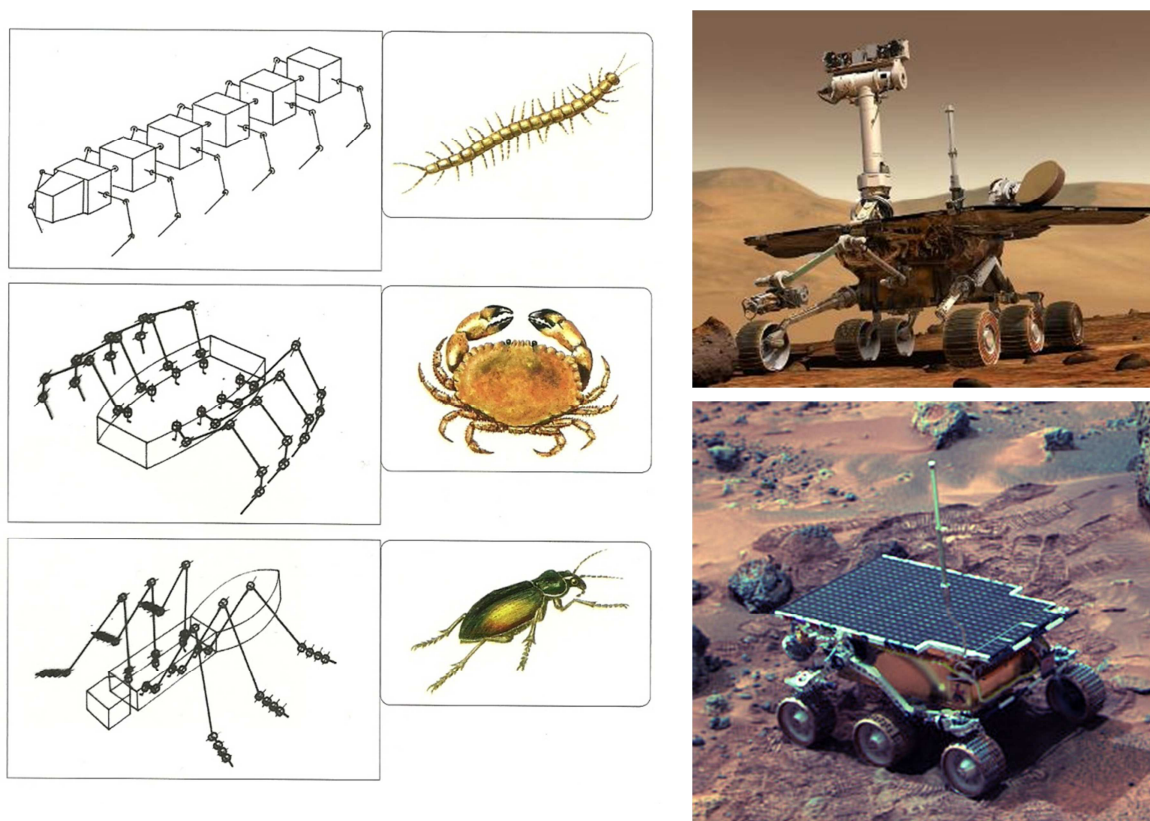
### 1. Introduction

When designing the chassis it is necessary to examine the conditions in which it will be to move the vehicle, which will carry out the tasks and the development of the concept of rolling systems in accordance with established rules of construction.

While the design has been used Dietrych design principles: the principle of optimal load, the principle of optimal materials, the principle of optimal stability, the principle of optimal values involved. These principles are guidelines when conducting the analyses and helped to get the most optimal ideas what was possible. [2]

### 2. The concepts

Before starting the development of concepts, review the existing solutions that have been implemented and tested as a basis for creating the concept of input. In this case, the development of the concept was started by analyzing research vehicles have been sent on fact-finding missions. Vehicles that have worked on missions such as Sojourner or Spirit are equipped with wheel trolley system that is less safe option but walking systems have greater adaptability in difficult terrain. The largest collection of systems solutions is rolling bionics. This science is the study of principles of living organisms and their application in technology and is rich in such solutions ranging from insects to arachnids arthropods to (Fig. 1). [3]



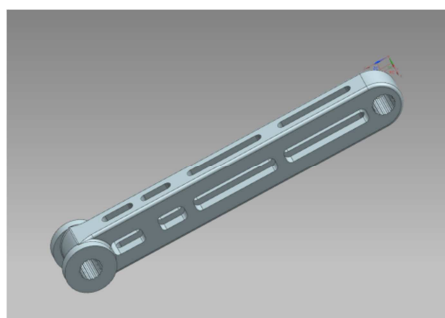
*Fig.1. Conceptual overview of bionics and vehicle research*

### 3. Creating the model

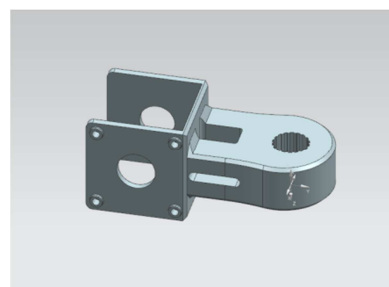
Construction of the research vehicle chassis consists of a few basic elements, such as the tibia (Fig. 2.), the thigh (Fig. 3) and the hip (Fig. 4.), in 1:4:5 ratio of length equivalent to the construction of insect legs. The legs are attached to the frame and driven by stepper motors.



*Fig.2. Model of the tibia*



*Fig.3. Model of the thigh*



*Fig.4. Model of the hip*

Number of legs is one of the most important criteria in the design of rolling robots. The most used system is a system consisting of four legs, which increases reliability and reduces the weight of the robot. Due to the use of fewer electronics in the form of control and drives,

but the sober steady gait can be moved only one leg, which limits ruchowość such work. Equally popular are the system works six - foot despite the fact that the failure rate is greater than the need for greater amounts of electronics, in contrast to four robots - foot during gait steady sedate move three legs (the fastest car). In Figure 5. based on the model of the vehicle chassis six-foot. [1,4]

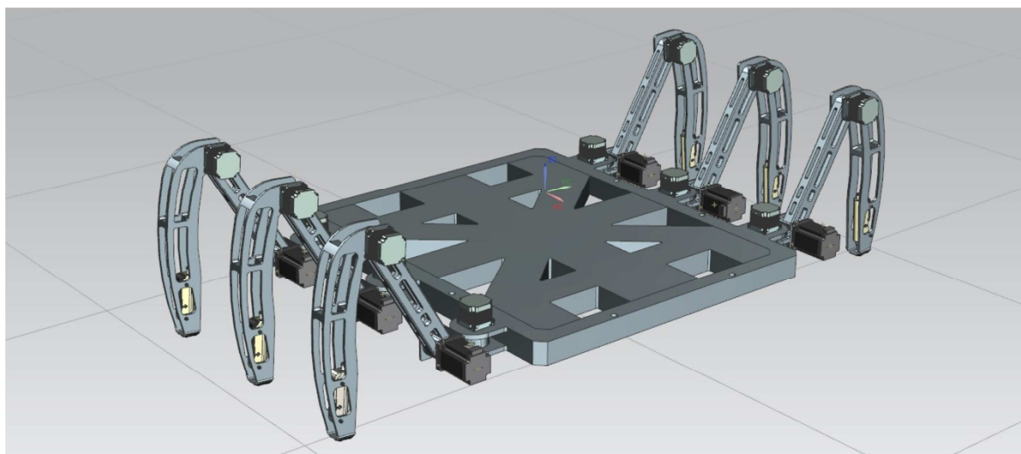


Fig.5. Assembling a research vehicle chassis

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

#### 4. Analysis

Performance analysis in Unigraphics NX 7.5: Nastran were modelled to optimize the design in terms of: choosing the right material, increase the strength, weight reduction, stability test, and any collision during movement. The first analysis was performed stress test max and min for Aluminium 2014, which showed the areas where there are the largest and the smallest stress.

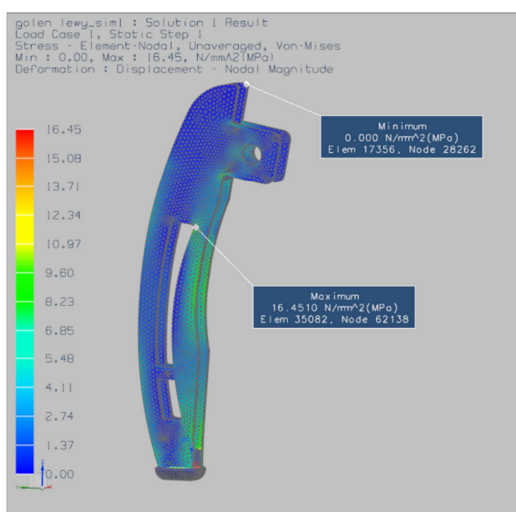


Fig.6. Tibia from optimization of 1.48 kg

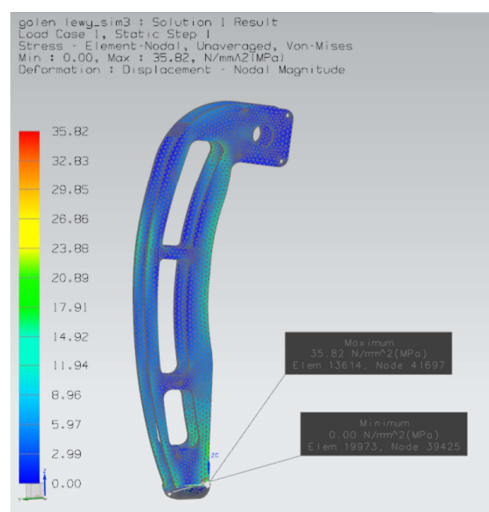


Fig.7. Tibia after optimization 0.68 kg

Areas that do not show significant load was reduced for up to equal distribution of stresses in the part. The quickest way to modify the new gear elements are provided in the program NX 7.5 Synchronous Modelling namely, so that we can quickly and efficiently move the wall, etc. The effect is to change the dimensions of the optimization was a significant reduction in the weight of which 1.48 kg (Fig. 6.) has been reduced by more than half (Fig. 7.) started keeping the maximum stress

Another study concerns the checking of vehicle stability. To determine the stability of the rolling, triangles should be set support. In Fig.8. triangles are determined more support for walking 3/6 period gait. It is important that the center of gravity S always in the middle of one of the triangles. Presented gait is the fastest way to statically stable robot to move a six - foot. Marked on Figure 8. thick line is the current triangle support, while the thin line of the triangle support for the next step. There is no need to set the triangles of support for other types of income (2/6, 1/6) because these versions support is implemented using four or more legs which gives greater stability.

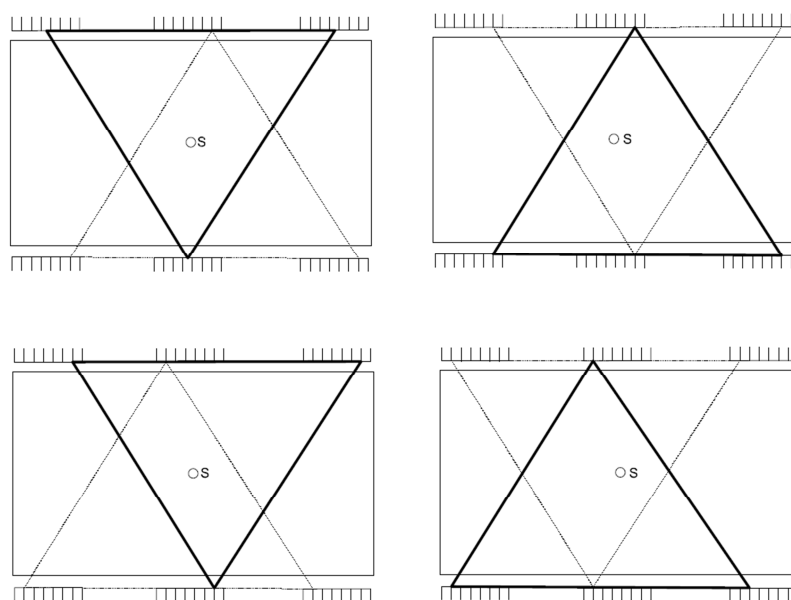


Fig.8. Another support for the walking triangles 3/6 period walking

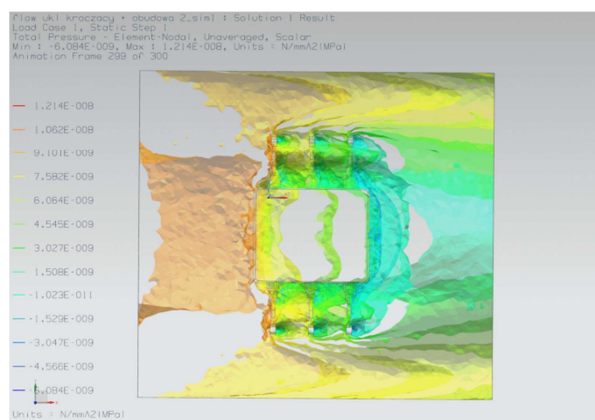


Fig.9. Aerodynamic analysis of the horizontal section to the upper part

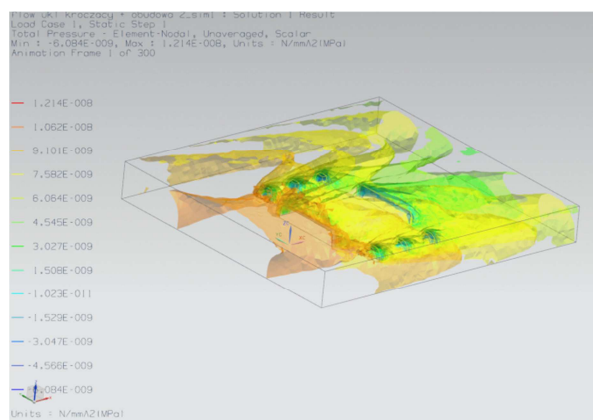
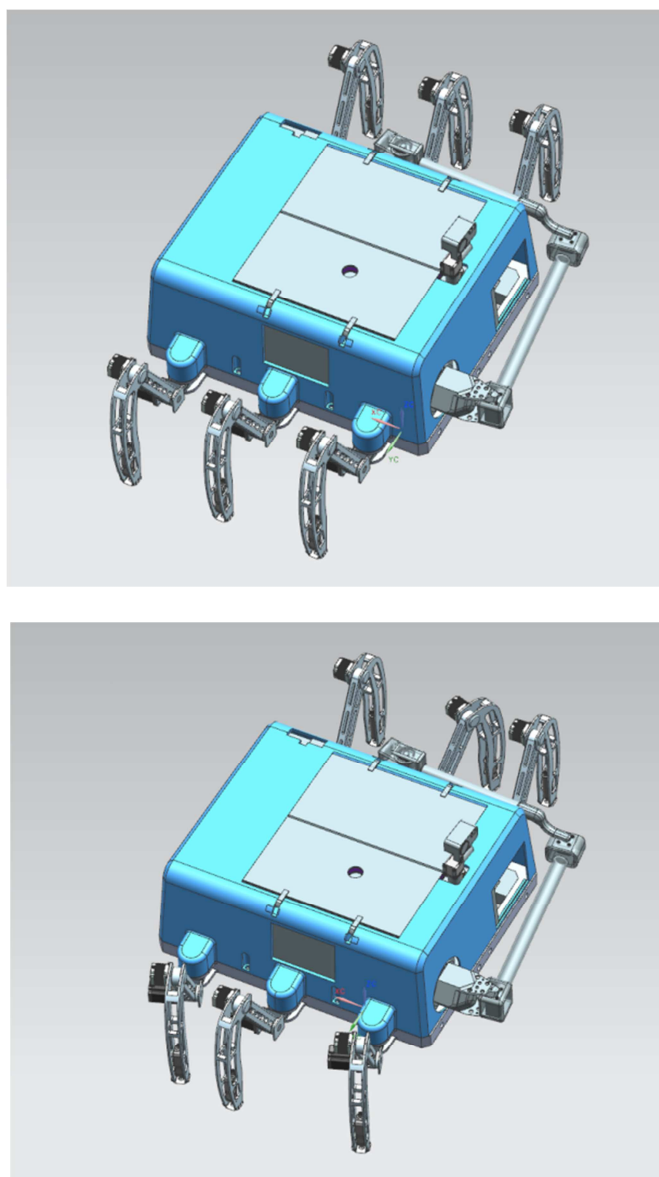


Fig.10. Aerodynamic analysis of the horizontal section to the bottom part

Another factor affecting the stability of the aerodynamics of the vehicle is rolling. It is important that the medical examination to determine the pressure distribution and its impact on the vehicle. The study shows that the pressure of the vehicle (Figure 9.) Is much greater than that which prevails under it (Figure 10.). We conclude from this that the vehicle will be pressed to the floor or get the required stability.

## 5. Motion simulation

The simulation allowed us to analyse traffic patterns for cars to move  $1/6$ ,  $2/6$ ,  $3/6$  period of time, and see if the solution design is done properly for possible collisions. Through simulation it is possible to display, mobility and functionality of the system rolling.



*Fig.11.The next steps repositioning the legs in walking 3/6 period*

## 6. Conclusions

When designing the chassis of the vehicle it is important to research a thorough grounding in the subject. Without this knowledge, and without the use of other sciences, such as Bionics is not possible to develop a concept that could bring something new to the concepts of existing research vehicles. To sum up the work of the modeling, analysis, strength, aerodynamics and motion simulation, please follow the simple rules defined by Dietrych. Guided by these principles, we can minimize design errors.

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