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Bachelor – Thesis - Proposal

Biologically Inspired Optimization of the Hybrid Quadruped Asguard Robot's legged-wheel Design

Fig. 1: ASGUARD robot, latest version with its four five-legged-wheels and rubber feet

The hybrid legged-wheeled robot Asguard (cf. Fig. 1) was build to combine both the advantages of wheels to move at high speed on even surfaces and legs to cope with rough terrain. These two features would make the system highly useful for numerous tasks like surveillance and search and rescue missions (SAR). Since the start of the project the wheels and feet were constantly modified and improved in order to make the system as light and rugged as possible (cf. Fig. 2). Furthermore the damping and the elastic properties are of high importance for the robots locomotion behaviour.

So far the legged-wheels perform well on rough terrain and manage to overcome various obstacles including gravel and sandy grounds, steep slopes and even stairs. Yet, on hard and flat ground the robot tends to lapse into a kind of bouncing pattern, which causes the wheels to loose traction. As a result the robot can only convert a very small amount of the motor's torque into advance.

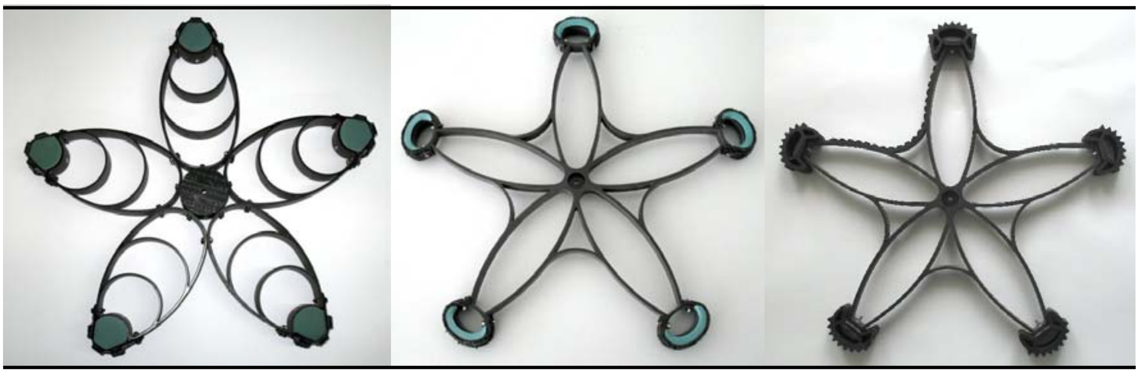

Fig. 2: Evolution of the legged wheel with feet (chronological from left to right)

The goal of this thesis is to optimize the Asguard's legged-wheels by applying the biomimetic top-down principle. That means to investigate how existing systems in nature cope with similar situations and transfer the gained knowledge into the technical system.

The first step of this optimization process is to analyse the behaviour of the wheels on hard ground. In order to come up with new concepts for the legged-wheel structure it is necessary to get a better understanding of the forces, stresses and loading cases that occur in the wheel. For this reason the wheel has to be analysed under real world conditions. The behaviour could be tested on a treadmill and for later analysis be recorded by a high speed camera. Forces between wheel and ground could be measured with a force plate.

The next step is to compare the collected data with the results of a computer simulation of the running wheel. For this purpose a CAD-model of the wheel has to be imported into a FEM-program where it gets meshed and the material properties are set. From there the model can be imported into a simulation program like ADAMS and be tested under different conditions. The results of these tests will help to analyse the weak points of the legged-wheel more precisely.

Coming up with new bio-inspired concepts and ideas to improve the current legged-wheel design is the final part of this study. In this context different concepts are to be developed and evaluated. The most promising of these concepts should be build with CAD and analyzed with the simulation program ADAMS.

Finally the optimized design will be compared to the current wheel structure and evaluated based on its performance.