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Wheelchair and Wheel Design with a Transformable and Adaptable Wheel-Leg Configuration for Climbing Stairs

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Background

Design of any structure is an essential part of the whole product to work as intended. One of the key elements is to examine the existing structures and redefine them by solving pending issues. Over time, some of the problems are solved, and the structure becomes more defined. Yet some of the minor or complex issues stay unsolved. In addition, due to the rapid change of the world and its needs, the defined model can experience new challenges that need to be eliminated in favor of adapting to the new realities.

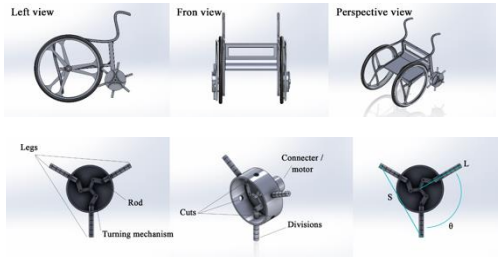
This work takes one of the locomotion vehicles for people with disabilities. A wheelchair, for many, is the main transporting machine that replaces some of the limbs. One can say that the vehicle for disabled people is the main source of locomotion. Hence, its ability to overcome some industrial and unpredictable obstacles is essential. Therefore, this work will look into modeling a wheel that is capable of changing its arrangements to fulfill certain tasks.

Objetive

1. To design and analyze a wheelchair that is capable of climbing stairs.
2. To vary different parameters for better understanding
3. To conclude the findings

Methodology

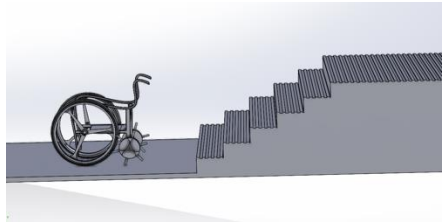
For the simulation to be performed, a model of the wheelchair was designed as seen in Figure 1. SolidWorks was used for analysis.



Equations used

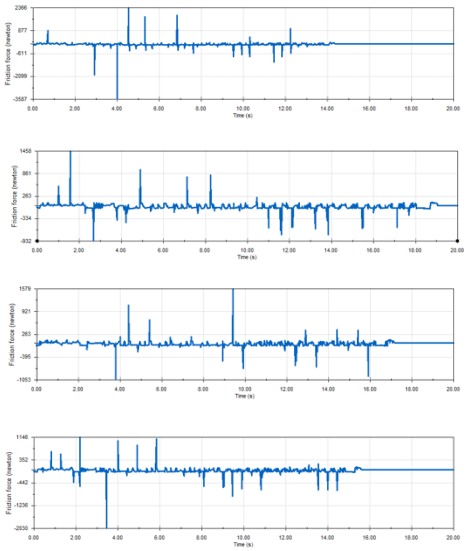
$$\theta = \arccos\left(1 - \frac{h}{L}\right) \qquad N \geq \frac{360^0}{\arccos\left(1 - \frac{h}{L}\right)}$$

The setup of the analysis



Results

Analysis were conducted using SolidWorks' built in Motion analysis. In total 41 simulations were carried out with varying certain parameters. Two table of results were gathered (Table 1 and Table 2). In the first intermediate results were gathered. These results helped to see the tendency. Therefore, using table 1 as the main sorcery for conducting more thorough analysis with further variation in parameters..



Conclusions/Recomendations

To conclude, the work aimed to design and analyze a wheelchair that is capable of climbing stairs. A slightly simplified structure was built and assembled in SolidWorks. The analysis of varying several parameters, such as leg length, number of legs, acting force, and rotor speed, was conducted to evaluate the performance of the structure using the same engineering tool. The results illustrated good correlations with other researchers' findings. Future improvement that can be implemented for better results: First and most important part is to perform a real-world experiment that could provide results for validation of gathered results from simulations of this work. Another improvement of the simulation can be by applying more relevant materials to the modeled parts. For instance, for this work, the following default materials were selected, which were acrylic and aluminum dry. The choice was put on these materials from the default materials of the software, as they illustrate higher value of coefficient of friction.

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Conflict of interest: none