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Apoio ao Projeto Mecânico de Desenvolvimento de um Miniveículo Elétrico Robótico

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Abstract

This project details the construction of a miniature vehicle with two independent electric motors, pure Ackermann steering, inertial navigation system (INS/GPS), onboard computer and CAN bus. It also includes a scanning range finder, cameras and encoders. The design started from an existing Baja platform. This car will be the basis for the development of an all-terrain autonomous vehicle, being part of a larger project called VERDE (Electric Robotic Vehicle with an Electronic Differential)1.

Key words:

Mobile Robotics, Autonomous Vehicle, Mechanical Project.

Introduction

A significant amount of scientific research in mobile robotics focus on the development of four-wheeled vehicles. Most of the effort focuses on well-behaved environments, which simplifies the computation of the tire-terrain contact conditions. The few projects that develop an all-terrain type of vehicle faces complex and new dynamic variables that do not scale linearly. One of the challenges that are faced is the torque distribution between the wheels. Most of the existing systems are limited, imposing different and proportional rotation speeds for the non-steering wheels during a curve. This system does not take into account the needed correct torque distribution to contemplate complex grip conditions, such as skidding, slipping and terrain irregularities.

To overcome this challenge a miniature vehicle with two independent electric motors was built. The arrangement allows the torque to be distributed as needed. Also, a pure Ackermann steering geometry was used to reduce tire slipping at low speeds. It was also necessary to embed several sensors to allow autonomous navigation, such as an inertial navigation system (INS/GPS), a scanning range finder (SOKUIKI sensor), cameras and encoders.

This project was carried through 2 years, because of its complexity and delays and it is now finished.[3]

Results and Discussion

The vehicle was based on a HPI Baja SS, which is a commercial RC off-road car. The engine and the fuel tank were removed, as well as the RC receiver and the steering motor. Then, almost all the parts had to be drawn on a CAD software so that the required building precision could be assured and the modifications could be designed.

It was observed that the original design had two major problems. The front suspension system added an undesired angle to the wheels when steered. The rear suspension had to be corrected because the wheels were not aligned correctly.

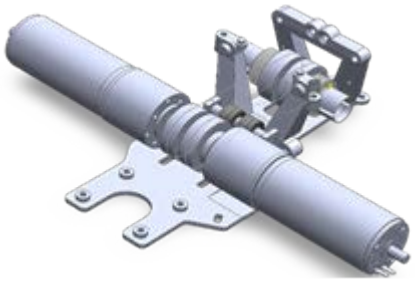

Image 1. Electronic Differential project.

Conclusions

Unlike other vehicles, this project presented a cost-effective solution for an all-terrain robotic vehicle. It contemplates all needed hardware systems for such implementation. The use of two electric motors was correctly chosen as it allowed for the much needed precision in torque input. The Ackermann steering reduced tire slipping to a minimum, which facilitated for trajectory correction by software. This project will allow for the next implementation step, which is altering the already existing *VERO* (External Robotic Vehicle)[2] project to be as complex as this one.

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[1] De Paiva, E. C. "Desenvolvimento de um Veículo Elétrico Robótico com Diferencial Eletrônico (Projeto VERDE)", Solicitação de Auxílio à Pesquisa – Regular à Fundação de Amparo à Pesquisa do Estado de São Paulo (Fapesp), Fev. 2014.

[2] Bueno, S. S.; Azevedo, H.; Mirisola, L. G. B.; de Paiva, E. C.; Ramos, J. J. G.; Victorino, A. C.; Azinheira, J. R. (2009). Uma plataforma para pesquisa e desenvolvimento em robótica terrestre de exterior. *IX Simpósio Brasileiro de Automação Inteligente*, Brasília, DF.

[3] Gatti Artaxo Netto, Pedro. Mechanical Support for the Development of a Miniature Robotic Electric Vehicle In*: XXIII Congresso de Iniciação Científica da Unicamp, 2015*.