Modelling Lunar Drivetrain Technology Through the Design of a Differential Swerve Drive

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This study aimed to develop a differential swerve module which imitated the drivetrain of future NASA Lunar Rovers, effectively exploring the usage of a four-wheeled drive system with two independent actuators on each wheel. The Space Exploration Vehicle (SEV) was the first human-supporting NASA space rover designed for the South Pole of the Moon that used a, "swerve drive," or highly maneuverable drivetrain powered by two motors per wheel that separately control the drive and steer. The SEV's chassis can be represented by standard swerve drive modules found in FIRST Robotics. While revolutionary in the usage of this drivetrain, future missions are attempting to implement a variable of swerve drive that can use the power of both motors to control drive or steer- differential swerve drive. In this model created in 3D computer-aided design software, PTC Creo Parametric, a design is proposed in which materials typically used in the FIRST Robotics Competition (FRC) demonstrate efficiency, speed, weight, and voltage drawn from the power distribution hub. The data found from the tested CAD model can be compared to the standard swerve drive module found in FRC, which will allow a statistical comparison between the two variants. With an overall driven gear ratio of 5.73:1 for the differential design, the model showed an increase in efficiency by 11% and a speed increase of 42.78%, with only a .55% increase in weight. The model was then physically tested, using 3D-printed carbon-fiber in place of aluminum parts. The physical differential swerve module allowed the motion to be proven- specifically utilizing a differential gearing such that both motors can power the drive ratio and the steering ratio.

Awards Won:
NASA: 3rd Prize