Feasibility study of swerve drives

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Quantitative study of the feasibility of swerve drive in wheelchair transport robot

Conditions

- Robot weight: 60kg
- Transported load: 100kg
- Maximum slope: 10 degrees
- Maximum step: 20mm

Traction Motor

駆動力/Traction force
搬送負荷をスロープで押し上げる力/ Force pushing up the transport load on the slope

Fp = 100kg * g * sin(10deg) = 170N

自重も含めた駆動力/ Driving force including its own weight

Ft = 160kg * g * sin(10deg) = 272N

1 輪あたりの必要駆動力は、おおよそ/The required driving force per wheel, approximately

Fw = 80N

when the speed is 1m/s

Po=80N * 1m/s = 80W

eg1) Commercially available wheels

https://www.amazon.co.jp/dp/B0BWYBLTK9

These wheel motors look fine.

Cantilever in-wheel motor

6.5 inch wheel (ϕ 165mm)

e.g.)

https://www.alibaba.com/product-detail/6-5-Inch-Hoverboard-Motor-Wheel_1600458838462.html

Encoder must be included in

Steer Motor

ホイールのスピントルク/spin torque between wheel and ground

Ts = μ mg rf

Large coefficient of friction μ =1.0

Load m=20kg

Effective Radius rf≒2/3 R

When the Ground contact radius R=15mm, rf ≒ 10mm

Thus、

Ts = 1.0 * 20kg * 9.8 * 0.01m ≒ 2Nm

ω =6 rad/s(60rpm) spin speed seems to be enough. So, 2Nm * 6 = 12W

When we use cantilever in-wheel motors, we can use a simple the steering mechanism.

ex1) Automotive power window motor

https://jp.robotshop.com/products/power-window-motor-with-coupling-right

Rating speed：60±15RPM

Rating torque：30Kg.cm（2.9Nm）

can use simple PWM controller

but, need an encoder

ex2) digital servo motor

https://jp.robotshop.com/products/feetech-180-degrees-digital-servo-74v-35kg-cm-ft5330m

Angle range: 180°

voltage: 7.4V

Torque: 35kg･cm (3.5Nm)

Need no encoder

Angle control available by PWM signal

Drive assembly