Robot Design and Competition
EN-2532
Assignment 7

Karunanayaka Y.S. 190301H

Department of Electronics and Telecommunication, University of Moratuwa,Katubedda

Dated: November 13, 2021

Servo Motors

In the below comparison, I am going to compare servo motor with BDC motors.

Torque	HIGH
Speed	LOW
Phases	Single Phase
Commutation	This uses a BDC, BLDC or AC motor internally. Therefor commutation will be done according to the motor.
Rotor	Field Windings
Stator	Permanent Magnets
Terminals	3 Terminals
Magnetic Field Generation	Permanent Magnets and Electro magnets
Angular Resolution	High
Motor Complexity	High
Control Mechanism	An internal circuit used to drive. A negative feedback is used to position encoding. The internal circuit will control the position according to 50 Hz (5-10) % duty cycle input.
Control Complexity	LOW (Internal circuit will handle the controlling)
Use of H bridge	NO (The internal circuit may use H bridges depends on the motor)
Driving Modes	N/A
Cost	Moderate
Advantages	High Angular resolution, Low control complexity, No need of external position encoders
Disadvantages	Only 0-180 degree rotation is possible
Commercially available product	Futaba S148 SG 90 MG 995

Stepper Motors

	Permanent magnet	**Variable Reluctance**	**Hybrid**
Torque	High	Low	Moderate
Speed	Driver Controlled	Driver Controlled	Driver Controlled
Phases	2	Multi-Phase	2
Commutation	Commutation done using MOSFET H bridge.	Commutation done using MOSFET H bridge.	Commutation done using MOSFET H bridge.
Rotor	Permanent Magnet	Iron Disk with teeth	Permanent Magnet (With teeth)
Stator	Field Windings	Field Windings	Field Windings (with teeth)
Terminals	Bipolar – 4 Unipolar – 5,6	4	Bipolar – 4 Unipolar – 5,6
Magnetic Field Generation	Electro Magnetic	Electro Magnetic	Electro Magnetic
Angular Resolution	Low	High	Moderate
Motor Complexity	Moderate	Moderate	Moderate
Control Mechanism	Bipolar – H Bridge Unipolar – 4 MOSFET switches	Bipolar – H Bridge Unipolar – 4 MOSFET switches	Bipolar – H Bridge Unipolar – 4 MOSFET switches
Control Complexity	Moderate	Moderate	Moderate
Use of H bridge	For Bipolar	For Bipolar	For Bipolar
Driving Modes	Full step, Half step, Micro step	Full step, Half step, Micro step	Full step, Half step, Micro step
Cost	Moderate	Moderate	High
Advantages	High Torque	High Angular Resolution	Good torque and resolution
Disadvantages	Low Angular Resolution	Low Torque	High Cost
Commercially available product	8PM020S1-02001 10PM020S1-04001	Tb6560	NEMA 34 NEMA 17

Brushless DC Motors

	In-Runner	Out-Runner
Torque	Low	High
Speed	High	Low
Phases	3	3
Commutation	6 Commutation Steps, Using 3 MOSFET half bridges.	6 Commutation Steps, Using 3 MOSFET half bridges.
Rotor	Inside the stator	Outside the Stator
Stator	Outside the stator	Inside the stator
Terminals	3	3
Magnetic Field Generation	Permanent Magnets and Electro Magnets	Permanent Magnets and Electro Magnets
Angular Resolution	N/A	N/A
Motor Complexity	LOW	LOW
Control Mechanism	Should use ESC, ESC is controlled by PWM signals. ESC uses 3 half bridges to switching	Should use ESC, ESC is controlled by PWM signals. ESC uses 3 half bridges to switching
Control Complexity	Moderate	Moderate
Use of H bridge	3 Half H bridges	3 Half H bridges
Driving Modes	N/A	N/A
Cost	High	High
Advantages	High Speed	High Torque
Disadvantages	High Cost, High Power consumption, Control Complexity	High Cost, High Power consumption, Control Complexity
Commercially available product	LBA2435	MTO2830-1300-S

Brushed DC Motors

	Permanent Magnet (PM)	**Series Wound (SWDC)**	**Shunt Wound (SHWDC)**
Torque	Moderate	High	Moderate
Speed	Driver Controlled	Driver Controlled	Constant speed
Phases	1	1	1
Commutation	Done using brushes	Done using brushes	Done using brushes
Rotor	Field windings	Field windings	Field windings
Stator	Permanent Magnets	Field Windings (Series with rotor)	Field windings (Parallel with rotor)
Terminals	2	2	2
Magnetic Field Generation	Permanent magnets and electro magnets	Electro magnets	Electro magnets
Angular Resolution	N/A	N/A	N/A
Motor Complexity	Low	Low	Low
Control Mechanism	Use H bridge to control direction and speed with PWM	Use H bridge to control direction and speed with PWM	Use H bridge to control direction and speed with PWM
Control Complexity	Low	Low	Low
Use of H bridge	Direction and Speed Control	Direction and Speed Control	Direction and Speed Control
Driving Modes	Breaking, Coasting, FWD, BKWD	Breaking, Coasting, FWD, BKWD	Breaking, Coasting, FWD, BKWD
Cost	Low	Moderate	Moderate
Advantages	Low cost and simple control	High starting torque	Constant speed
Disadvantages	Magnets decay. (low durability)	Hard to control speed	Speed is not variable
Commercially available product	ZGB37RG	ZC-1200	