SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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Chennai

DEPARTMENT OF AEROSPACE ENGINEERING

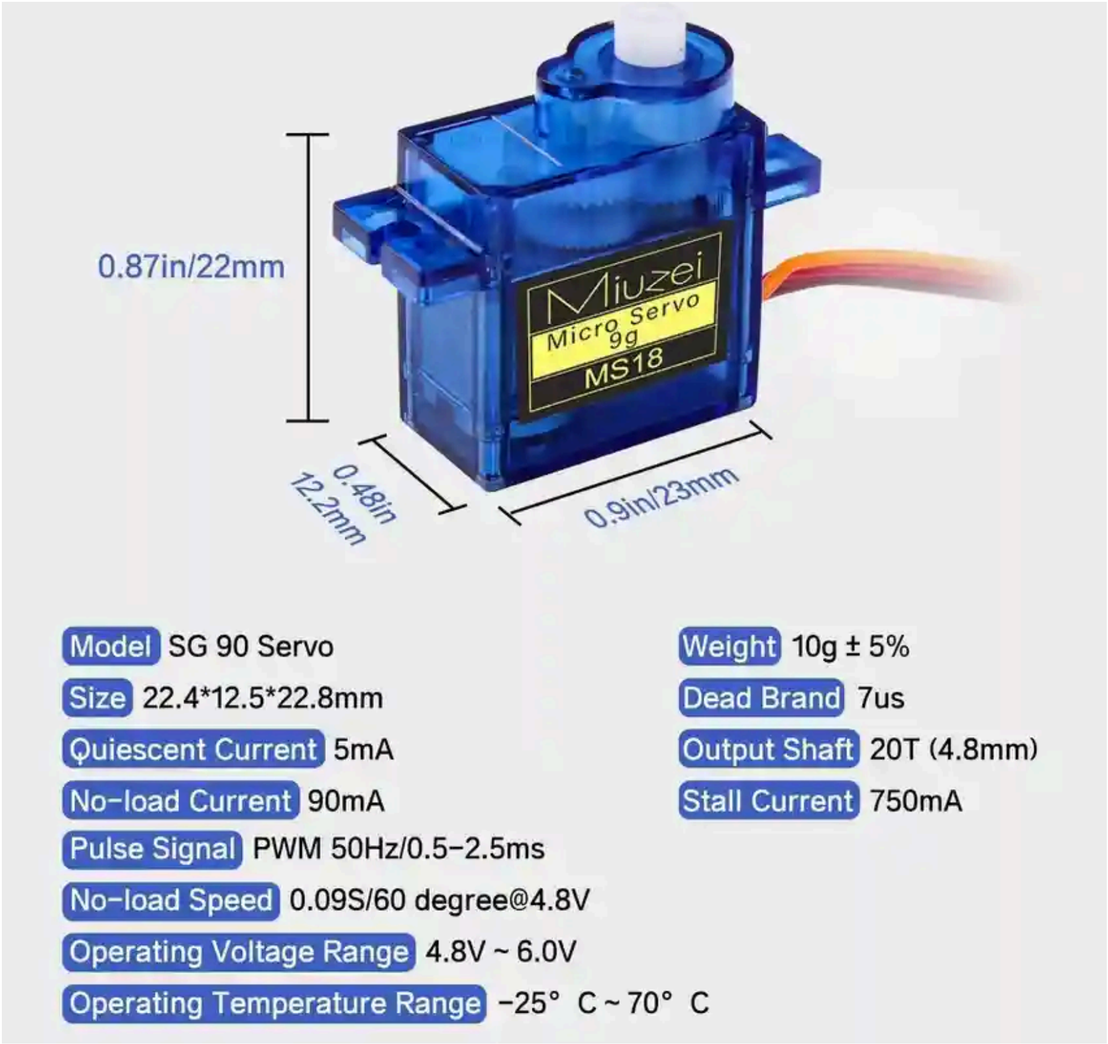
19ASZ301– ROBOTICS & AUTOMATION IN SPACE

III YEAR VI SEM

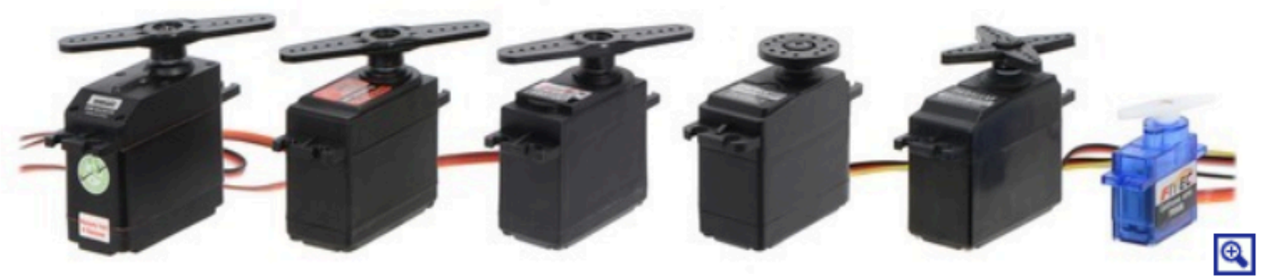
UNIT 3 –MOTION CONTROL AUTOMATION

TOPIC - Sizing of Servo motor for Specific Applications

SERVO MOTOR


0.87in/22mm
Miuzei
Micro Servo
9g
MS18
0.48in
12.2mm
0.9in/23mm
Model SG 90 Servo
Size 22.4*12.5*22.8mm
Quiescent Current 5mA
No-load Current 90mA
Pulse Signal PWM 50Hz/0.5-2.5ms
No-load Speed 0.09S/60 degree@4.8V
Operating Voltage Range 4.8V ~ 6.0V
Operating Temperature Range -25° C ~ 70° C
Weight 10g ± 5%
Dead Brand 7us
Output Shaft 20T (4.8mm)
Stall Current 750mA

SIZING OF SERVOS



Continuous rotation servo size comparison. From left to right: SpringRC SM-S4303R, Power HD AR-3606HB, FEETECH FS5106R, Parallax Feedback 360°, Parallax (Futaba S148), and FEETECH FS90R.

	6 V		4.8 V						
	Max speed (RPM)	Stall torque (oz·in)	Max speed (RPM)	Stall torque (oz·in)	Weight (g)	Size (mm)	Digital?	Feedback?	Price
SpringRC SM-S4303R	54	71	43	46	41	41.3 × 20.7 × 40.2			$12.95
PowerHD AR-3606HB	71	93	62	83	40	40.5 × 20.0 × 38.0			$14.95
FEETECH FS5106R	95	83	78	70	39	40.8 × 20.1 × 38.0			$13.95
Parallax Feedback 360°	140	35	–	–	41	40.0 × 20.0 × 37.2	✓	✓	$27.99
FEETECH FT90R	170	21	135	18	9	22.9 × 12.1 × 26.5	✓		$7.95
FEETECH FS90R	130	21	100	18	9	23.2 × 12.5 × 22.0			$4.95

SELECTION PROCESS OF SERVOS

✅ **1. Define the Robotic Application**

Examples:

- Robotic arm joint
- Pick-and-place actuator
- Precision gripper rotation
- Mobile base drive

Each application will have:

- Load characteristics
- Motion profiles
- Torque and speed needs

✅ **2. Determine Load Parameters**

a. Mass or Inertia (J_l)

- Rotational load → Moment of inertia ($kg \cdot m^2$)
- Linear load → Equivalent inertia = Mass × $(Radius)^2$

b. Load Center Distance

- Affects torque due to arm length:
- T = F × d where d is distance from rotation axis

✅ **3. Define Motion Profile**

Determine:

- Required acceleration (α)
- Required velocity (ω)
- Travel distance or rotation angle (θ)
- Dwell times and number of cycles

✅ **4. Calculate Torque Requirements**

a. Acceleration Torque (T_a)

$Ta=Jtotal \times \alpha$ Where:

- $Jtotal=Jload+Jmotor+Jgear$
- $\alpha=\Delta\omega\Delta t$

b. Friction Torque (Tf)

Based on sliding surfaces, estimated or measured.

c. Gravitational Torque (Tg)

For vertical movement:

$Tg=m \times g \times r$ Total Required Torque

$Ttotal=Ta+Tf+Tg$

✅ **5. Determine Required Speed**

$\omega=2\pi \times RPM60$

$\omega=602\pi \times RPM$Use required movement time to find peak and continuous speeds.

✅ **6. Check Duty Cycle**

Define how often the servo runs vs. rests. This affects thermal sizing and continuous torque ratings.

✅ **7. Apply Safety Factor**

Usually:

- 1.5× to 2× safety margin on torque
- Helps handle unexpected loads, misalignment, or wear


Thank You