LOCOMOTIONS (UR): KEY DESIGN ISSUES, ATTRIBUTES, BASIC THEORETICAL MODEL, PAYLOAD.

SAAB SEAEYE FALCON

Locomotion System

- Type: Remotely Operated Vehicle (ROV)
- Thrusters: 5 thrusters — 4 horizontal (vectored) + 1 vertical
- Movement: 6 Degrees of Freedom (surge, sway, heave, roll, pitch, yaw)

Attributes

- Compact: Easily deployable from small vessels
- Highly maneuverable: Can hover, rotate, and hold position
- Vector thruster layout: Enables precise station-keeping

Key Design Issues

- Precise control in turbulent offshore environments
- Thrust vectoring needs to compensate for drag from tether
- Cable drag effect due to umbilical limits speed and agility

Payload

- Multi-beam and imaging sonar
- Colour zoom camera + LED lights
- Manipulator arm (1–2 function)
- USBL transponder for positioning

SAAB SEAEYE FALCON

📐 Basic Theoretical Model

- Equations of Motion (based on Newton-Euler):

$$M\dot{v}+C(v)v+D(v)v+g(\eta)=\tau$$

- M: Mass + added mass
- C(v): Coriolis forces
- D(v): Hydrodynamic damping
- g(η): Gravitational and buoyant forces
- τ: Generalized thrust input from 5 thrusters

BLUEROV2

Locomotion System

- Type: Low-cost ROV (open-source)
- Thrusters: 8 T200 thrusters (4 vertical, 4 angled)
- Movement: Full 6 DOF — Can pitch, roll, yaw independently

Attributes

- Highly customizable (hardware & software)
- Open-source control via ArduSub (based on PX4)
- Rated for 100m or optional 300m

Key Design Issues

- Low-cost design requires durable but affordable components
- Pressure sealing for electronics in open-source housing
- Smooth dynamic control for educational and research tasks

Payload

- HD camera with tilt servo
- IMU, pressure/depth sensor, temperature sensor
- Optional: sonar, gripper, water quality sensor

BLUEROV2

BLUEROV2

📐 Basic Theoretical Model

- Dynamic force control model with PID stabilization:

$$F = m \cdot a \Rightarrow \text{Thruster Force} = m \cdot (dv/dt)$$

- Plus PID control to reduce the error between the desired and current states:

$$u(t) = Kp \cdot e(t) + Ki \cdot \int e(t)dt + Kd \cdot de/dt(t)$$

REMUS 600 (HYDROID/KONGSBERG)

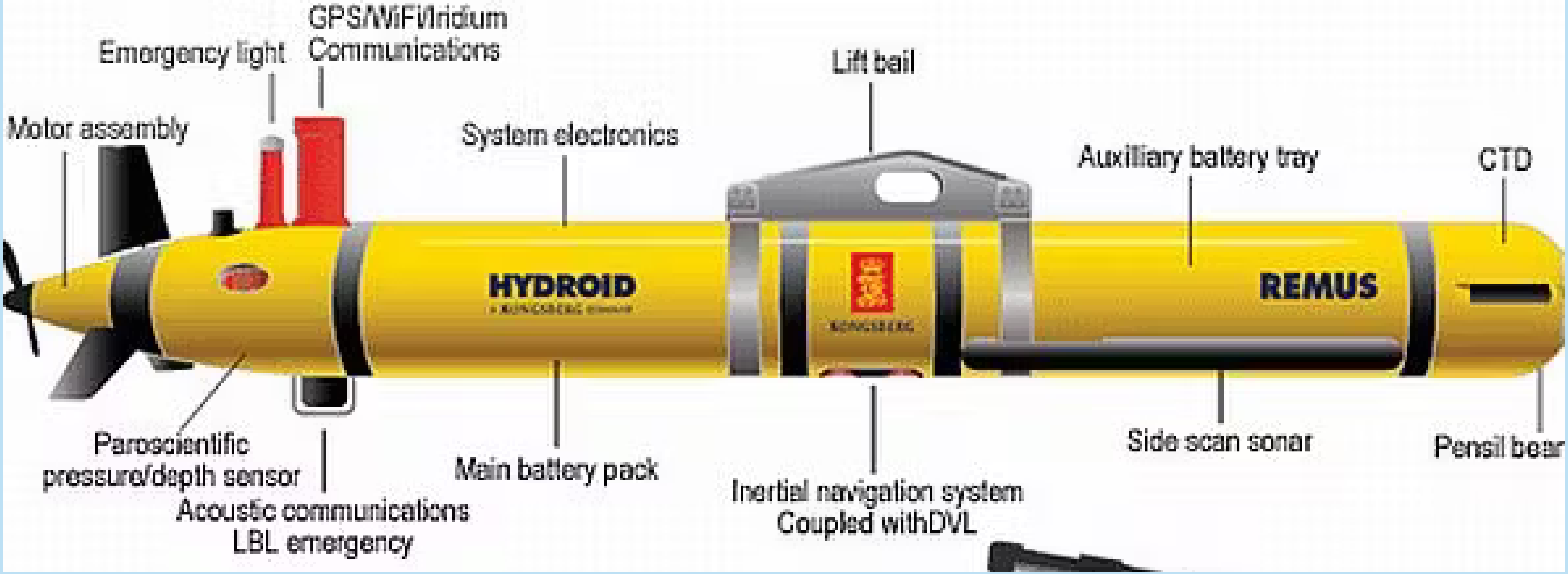
Locomotion System
- Type: Autonomous Underwater Vehicle (AUV)
- Propulsion: Single rear propeller
- Control: 4 control fins (pitch, roll, yaw)
- Movement: 5 DOF — cannot control lateral sway

Attributes
- Torpedo shape for efficient hydrodynamics
- Navigates via DVL (Doppler Velocity Log), INS, acoustic pingers
- Operational depth: 600 m

Key Design Issues
- Autonomous operation with no real-time remote control
- Accurate navigation in GPS-denied environment
- Battery optimization for endurance vs performance

Payload
- Side-scan sonar
- CTD sensors (conductivity, temperature, depth)
- Cameras, data logger, USBL modem

REMUS 600 (HYDROID/KONGSBERG)



REMUS 600 (HYDROID/KONGSBERG)

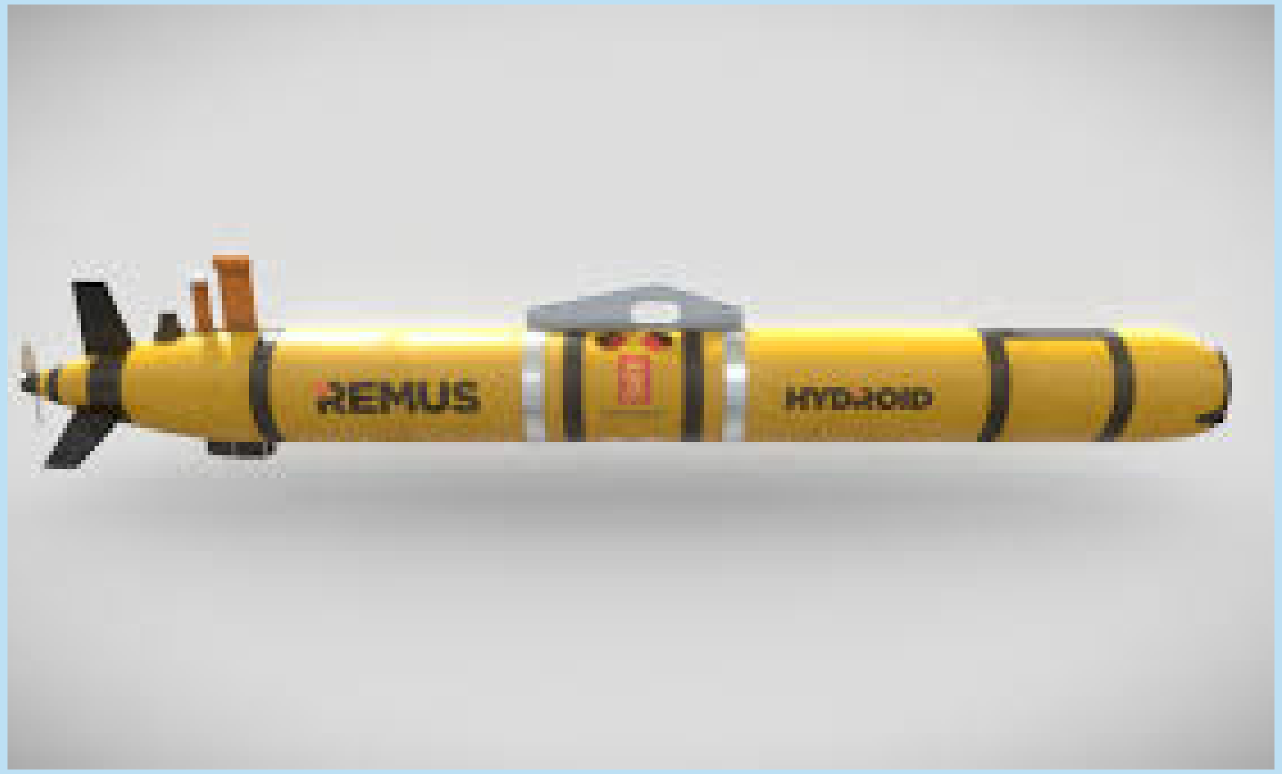
📐 Basic Theoretical Model

- Hydrodynamic drag model:

$$Fd = 1/2 \cdot [\rho \cdot Cd \cdot Av^2]$$

- Gliding motion model based on angle of attack and lift/drag forces:

$$Fl = 1/2 \cdot [\rho \cdot Cl \cdot Av^2]$$



HUGIN (KONGSBERG/OCEAN INFINITY)

Locomotion System

- Type: AUV (high-end)
- Propulsion: Low-noise electric propeller
- Control: 4 fins (2 horizontal, 2 vertical) for dive and steer
- Movement: 5 DOF, very stable and precise

Attributes

- Advanced autonomy and fault tolerance
- Deep-sea rated for ocean floor mapping
- Inertial + terrain navigation without surfacing

Key Design Issues

- Must withstand 6000 m depth (~600 bar pressure)
- Precision navigation without surfacing
- Real-time data management onboard

Payload

- Synthetic Aperture Sonar (SAS)
- Sub-bottom profiler
- Magnetometer, HD video
- Swappable modular bays

HUGIN (KONGSBERG/OCEAN INFINITY)

HUGIN (KONGSBERG/OCEAN INFINITY)

📐 Basic Theoretical Model

- Full 6 DOF nonlinear vehicle dynamics:

$$\tau = M\dot{v} + C(v)v + D(v)v + g(\eta)$$

$$\tau = B \cdot T$$

where:

- B : actuator configuration matrix
- T : input thrust vector

DEEP TREKKER DTG3

Locomotion System
- Type: Compact portable ROV
- Thrusters: 2 horizontal + 1 vertical thruster
- Movement: 4 DOF — surge, heave, yaw, limited pitch

Attributes
- Unique spherical design for center-balanced rotation
- Quick deploy — no need for tether management systems
- Battery-powered, internal sealed hull

Key Design Issues
- Minimal thruster count = limited maneuverability
- Balancing buoyancy and pressure tolerance in a spherical shell
- Stable image capture in confined spaces

Payload
- 4K low-light camera
- Sonar, claw arm
- Laser scaler, sediment sampler (optional)

DEEP TREKKER DTG3

DEEP TREKKER DTG3

📐 Basic Theoretical Model

- Simplified motion control:

$$T = F - D - W + B$$

where:

- F : Thrust
- D : Drag
- W : Weight
- B : Buoyancy

CONCLUSION

ROV/AUV	Thruster/Propulsion	Control Surface	DOF	Max Depth	Control Method	Navigation
Saab Seaeye Falcon	5 vectored thrusters	None	6	1000 m	Tethered	Operator + USBL
BlueROV2	8 vectored thrusters	None	6	300 m	Tethered (ArduSub)	IMU + depth
REMUS 600	Propeller + 4 fins	Yes	5	600 m	Autonomous	INS + DVL
HUGIN	Propeller + 4 fins	Yes	5	6000 m	Autonomous	INS + Terrain
Deep Trekker DTG3	3 thrusters	None	4	200–300 m	Tethered	Camera-only

REFERENCES

1. Saab Seaeye Ltd. (2023). Falcon Specification Sheet. Retrieved from:https://www.saabseaeye.com/falcon
2. Blue Robotics. (2024). BlueROV2 Technical Details and Sensor Integrations. Retrieved from: https://bluerobotics.com/store/rov/bluerov2
3. Kongsberg Maritime. (2023). REMUS 600 Autonomous Underwater Vehicle. Retrieved from: https://www.kongsberg.com/maritime/products/marine-robotics/remus
4. Kongsberg Maritime. (2024). HUGIN Autonomous Underwater Vehicle System Overview. Retrieved from: https://www.kongsberg.com/maritime/products/marine-robotics/hugin-auv-system
5. Deep Trekker. (2023). DTG3 ROV Product Brochure & Tech Specs. Retrieved from: https://www.deeptrekker.com/products/dtg3

THANK YOU