

**PLANNING AND NAVIGATION
(UR): SENSE AND AVOIDANCE
SYSTEM, PATH PLANNING,
AUTONOMOUS CONTROL,
SWARMING.**

SAAB SEAEDGE FALCON



Sense and Avoidance System:

- Equipped with Tritech Micron sonar or Gemini sonar (optional).
- Sonar provides 2D real-time obstacle detection; however, no AI interpretation—relies on the operator's awareness.
- It uses an internal compass and depth sensor for spatial orientation.
- Avoidance is manual: the pilot interprets sonar and navigates accordingly.

Path Planning:

- No autonomous route computation.
- Joystick-operated, but includes:
 - Depth lock (maintains depth)
 - Heading hold (maintains heading)
- Optional mission scripting via third-party control systems for pre-set movements (limited).

SAAB SEAEDGE FALCON

- Autonomous Control:
 - Semi-autonomous only: Keeps heading and depth steady.
 - All real-time adjustments done by human operator on surface.
 - No onboard AI or machine learning features.
- Swarming:
 - Not supported. System designed for single-operator, single-ROV deployment.
 - No inter-vehicle communication protocols.



BLUEROV2



Sense and Avoidance System:

- Optional Ping360 scanning sonar or Ping Echosounder for obstacle detection.
- Built-in IMU, barometer, leak detector, and compass.
- The operator must interpret Sonar visual data (no automated avoidance yet).
- Low-cost sensors = limited precision in cluttered environments.

Path Planning:

- Supports waypoint missions via QGroundControl (ArduSub).
- The operator can set:
 - Waypoints with lat/lon
 - Depths
 - Speed
- No real-time path replanning (unless externally programmed via MAVLink + companion computer).

BLUEROV2



BLUEROV2

Autonomous Control:

- ArduSub firmware supports:
 - Depth hold
 - Roll/pitch stabilization
 - Heading lock
 - Manual and waypoint-based control
- Advanced autonomy possible with companion computer (Raspberry Pi, Jetson Nano) + scripting.

Swarming:

- ROS (Robot Operating System) can be integrated to coordinate multiple BlueROV2 units.
- Experimental swarming and mission coordination possible (but complex to implement).



REMUS 600 (HYDROID/KONGSBERG)



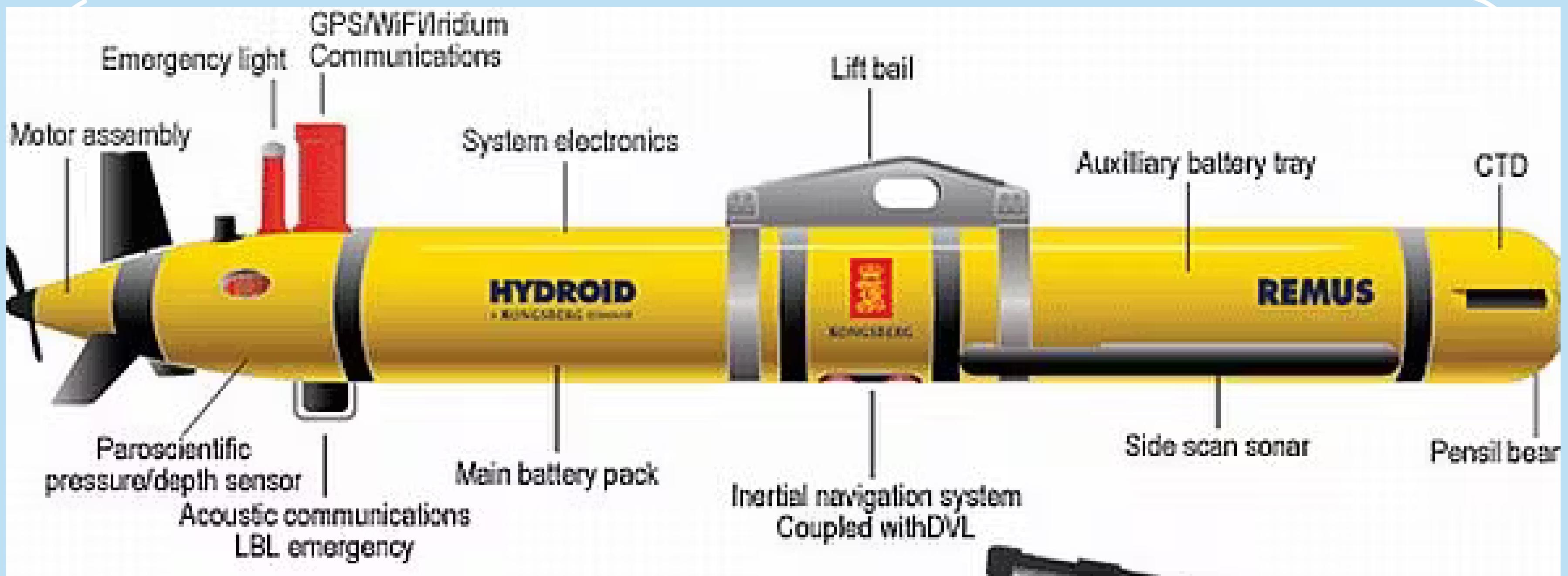
Sense and Avoidance System:

- Forward-looking sonar (FLS), side-scan sonar, acoustic Doppler current profiler (ADCP).
- Uses Terrain-Aided Navigation (TAN)—compares real-time sonar maps to onboard map database for precise positioning.
- Equipped with collision avoidance algorithms to reroute automatically when close to obstacles.

Path Planning:

- Uses REMUS Vehicle Interface Program (VIP).
- Pre-mission route planning with grid mapping, terrain following, or corridor search.
- Can dynamically change path based on sonar data mid-mission.

REMUS 600 (HYDROID/KONGSBERG)



REMUS 600 (HYDROID/KONGSBERG)

Autonomous Control:

- Fully autonomous:
 - Auto-start mission
 - Auto abort on malfunction
 - Adaptive pathing
 - Real-time mission reconfiguration
- Based on mission scripts uploaded before deployment.

Swarming:

- Supported coordinated deployments.
- Communicates with base station and/or other REMUS via WHOI Micro-Modem (acoustic comms).
- Used in naval mine countermeasure swarms.



HUGIN (KONGSBERG/OCEAN INFINITY)

Sense and Avoidance System:

- Multi-beam echo sounders (MBES)
- Synthetic Aperture Sonar (SAS)
- Forward-looking sonar with real-time collision avoidance
- Autonomous terrain mapping and seabed feature detection.

Path Planning:

- Programmed with NavLab and HUGIN Mission Planner (HMP).
- Can execute complex routes:
 - Zigzag
 - Spiral descent
 - Terrain-following at fixed altitude
- The onboard system can adaptively reroute if obstacles or unexpected terrain appear

HUGIN (KONGSBERG/OCEAN INFINITY)



We call it
Seabed
Intelligence

HUGIN (KONGSBERG/OCEAN INFINITY)

Autonomous Control:

- Fully autonomous with:
 - Multiple fault-handling layers
 - Redundant navigation systems (INS, DVL, GPS when surfaced)
 - Onboard AI mission planner
- Can conduct missions for up to 72 hours continuously.

Swarming:

- Supports coordinated surveys using multiple HUGINs.
- Communication via Kongsberg cNODE acoustic transceivers.
- Synchronization enables simultaneous area coverage and relay.



DEEP TREKKER DTG3



Sense and Avoidance System:

- Standard version lacks sonar.
- Optional add-on: Tritech Micron sonar for basic forward vision.
- Built-in:
 - Gyroscope
 - Accelerometer
 - Depth sensor
 - Compass
- No automated collision detection or avoidance.

Path Planning:

- Fully manual operation.
- Pilot visualizes surroundings via 4K camera.
- Manual path correction using real-time video and controller.

DEEP TREKKER DTX2 VECTORED ROV



DEEP TREKKER



DEEP TREKKER DTG3



DEEP TREKKER DTG3

Autonomous Control:

- Basic assisted modes only:
 - Depth lock
 - Heading lock
- No autonomous mission execution or waypoint support.

Swarming:

- Not applicable.
- Each DTG3 unit requires a separate human operator.



CONCLUSION

Feature	Saab Falcon	BlueROV2	REMUS 600	HUGIN AUV	Deep Trekker DTG3
Obstacle Detection	Basic sonar	Optional sonar	Multimodal sonar/TAN	SAS + MBES + AI	Optional sonar only
Collision Avoidance	Manual	Manual	Autonomous	Fully autonomous	None
Waypoint Planning	Limited/manual	Full via QGC	Yes (grid, zigzag)	Advanced mission scripts	None
Autonomous Control	Semi-autonomous	Basic autonomous	Full (auto-replan)	Full AI mission logic	Assisted only
Swarming Capability	No	Experimental via ROS	Yes (acoustic modem)	Yes (fleet operations)	No

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**THANK
YOU**