Research on Unpiloted Vehicles

# Attributes of UAVs

## Concepts

* Propulsion type
* Overall dimension (L x W x H)
* Fuel type – Diesel vs Battery
* Max payload (weight)
* Take-off type: Vertical Take Off and Landing (VTOL) technology vs. runway
* Max. Speed – 370 km/h
* Max. elevation
* Max. Range (1000 km)

## Issues to investigate

Electric is battery powered. Is battery type a factor in simulation?

Russian Drones [SwarmAttack]

* Written Sept, 18, 2025
* Can have 200 drones in one swarm.
* Immune to EW attack
* Packed with explosives and used like missiles
* Countered with Interceptor Drones that can chase down targets.
  + Cheap drones fast enough to catch up to attack drone and ram into it with small warhead.
  + Need to be twice as fast as drones to catch them.
  + FPV drone

FPV drone

* Drone controlled from First-Person perspective/View (FPV). Pilot wears goggles that transmit live video feed from camera on the drone.

# Propulsion Systems

[Propulsion]

Fixed-Wing drone propulsion – Rely on wings for lift. Propulsion is typically located in the rear or front. Provide forward thrust rather than vertical lift.

* Engines used in fixed-wing: both electric and internal combustion.

Multi-Rotor Propulsion – e.g. quadcopters. Known for agility, stability, and ability to hover in place.

* Can change motor speeds dynamically and maneuver precisely, maintain stability even in challenging conditions.

Gas-Powered Drones internal combustion engines

* Use fuel sources like gasoline or diesel
* Electric is more efficient in small-scale drones
* Combustion engines for larger drones or long-duration flights.

Type of propulsion system depends on the application of the drone.

* Military Drones – hybrid or combustion engine systems for extended range, high-speed flight, endurance. Used for surveillance, reconnaissance, and sometimes offensive operations.
* Commercial Drones
  + Agricultural monitoring, delivery services, infrastructure inspection
  + Electric or hybrid systems
  + Short-range tasks – electric
  + Hybrid – greater range and flight duration
* Consumer Drones
  + Photography, videography – electric propulsion – simplicity, low cost, ease of maintenance
* Industrial Drones
  + Tasks requiring heaving lifting
  + Construction, search and rescue, firefighting,
  + hybrid or fuel-based propulsion systems – higher power output

Future Trends

* Hydrogen Fuel Cells – alternative to traditional batteries & combustion engines
* Solar Power Integration – extended missions due to recharging during flight
* Autonomous Power Management – AI & machine learning used to optimize power distribution in real-time based on flight conditions and energy availability
* Distributed Propulsion – multiple small motors across drone’s frame.
  + Increases redundancy, improves stability, reduces likelihood of total system failure.

# UGVs in Ukraine

* Written 16 July 2025
* UGVs being used in Ukraine
* Ease pressure on infantry
* First mission Dec. 2024.
* July 2025 – first time UGVs (Ground Drones) captured Russian troops without use of infantry. Used solely UGVs and ground-based robotic systems.
* Used FPV drones and kamikaze ground robotic platforms to attack Russian fortifications. [CaptureUGV]
* Destroyed Russian bunkers with kamikaze drones.
* As another robot approached a damaged Russian holdout, remaining soldiers chose to surrender.
* Guided out of combat zone by drones, into custody.

# Jackal UGV Sales Web Page

* Onboard PC connects to Robot Operating System (ROS), RVIZ and Gazebo model.
* Remote Viewing Instructional Services (RVIS)
* ROS Visualization (RVIZ)
* Wireless connectivity via Bluetooth and wifi
* Add sensors, cameras, and other accessories to mounting platform
* 5V, 12V, 24V power options.
* Internal area can be used for additional computing power or storage.
* Aluminum chassis
* 4x4 drivetrain for all-terrain operation.
* Possible accessories:
  + Gen3Lite – robotic arm. Remote tele-operated manipulation on small ugvs.
  + Lidar
  + GPS
  + Stereo Camera
* Vision Package
  + LiDAR SLAM
  + Navigation in challenging environments
  + LiDAR SLAM – Light Detection and Ranging (LIDAR) Simultaneous Localization and Mapping (SLAM). Map environment & determine sensor’s location with that map.
  + 2D x 2 cameras
  + Backpack PC in custom IP54 enclosure
* IndoorNav
  + Mapping and navigation with obstacle detection
* Inertial Measurement Unit (IMU) – measures and reports a body’s specific force, angular rate, and sometimes the magnetic field surrounding the body using combination of accelerometers, gyroscopes and sometimes magnetometers.
* Other accessories:
  + Grippers
  + SoftHand – robotic hand with a soft grip.

Gazebo

* Gazebo Model
* Gazebo – used to build worlds for a robot
  + Open-source robotics simulator
  + Provides high-fidelity, physically realistic 3D environment for testing and prototyping robots in complex indoor and outdoor settings.
* Learn to build a model and simulate a 4-wheeled mobile robot in Gazebo using URDF and Zacro.

# Underwater Vehicle

[Bluefin]

* Propulsion: Gimbaled, ducted thruster (For torpedo-looking vehicles)
* Integrated Payloads & Sensors
* Bluefin HAUV – Hovering Autonomous Underwater Vehicle (HAUV)
  + Can be mine countermeasure
  + Propulsion – five thrusters for propulsion and control

[L3Harris]

* Propulsion: Brushless DC motor with three-blade stainless steel propeller

[Teledyne]

* May have wings – Autonomous Underwater Glider

# Surface Vehicle

[TeledyneSurface]

* Z-Boats Used for surveying
* Use Acoustic Doppler Current Profilers (ADCPs) in streams, rivers, lackes & costal water.
* 3 hulls connected (main plus 2 outriggers)
* 2 thrusters, one in each outrigger.
* Top speed, amount of time it can run (lifespan)

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