

UAVs & Military Robots

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Overview

- Definitions
- Types of UAVs
- Civil UAVs
- Military UAVs
 - Small Sized
 - Medium Sized
 - Big Sized
 - Helicopter Drones
 - Missiles
- On Ground UGVs
- On/Under-Water

Definitions: UAV/UAS

UAV = Unmanned Aerial Vehicle

- Re-usable aircraft
- flies autonomously or remote-controlled

UAS = Unmanned aircraft system

- 3 components: UAV, tracking station and master station

Types of UAVs

MUAV = Mini Unmanned Aerial Vehicle

- Always remote controlled
- Almost similar to model aircrafts
- Range about 10 km
- Area about 250 meter
- Activated about 1 hour

Types of UAVs

MAV = micro aerial vehicle

- One person can carry and controll it
- Size about 15 centimeter
- Range of few kilometer
- Altitude of several hundred meter
- Not heavy enough to have a solid fly

Types of UAVs

OAV = organic aerial vehicle

- Increases human senses on battlefield

RPV = remotely piloted vehicle

- Remote control drones

UACV = unmanned combat aerial vehicle

- Armed for combat

Types of UAVs

TUAV = tactical unmanned aerial vehicle

- Medium size
- Weight till 300 kg
- Area about 1000-5000 meter
- Activated 1-6 hours
- Range of 200-300 meter
- Launch with catapults or rockets

Types of UAV's

URAV = unmanned reconnaissance aerial vehicle

- Can stay 1-2 days in air

**VTUAV/VTOL UAV = vertical takeoff and
landind unmanned aerial vehicle**

- Launch and landing vertical

Definition

HALE = High Altitude Long Endurance

- Area over 15 000 meter
- Activated over 24 hours
- Good overview about the ground
- Just few countries can protect this heights

Definition

MALE = Medium Altitude Long Endurance

- Area about 500-15 000 meter
- Activated more than 24 hours
- Tactical research for targets

Advantages

- Endurance till 2 days possible
- Lower constructions costs as theres no space for a pilot needed
- No human pilots have to risk their lifes
- UAV need no education only new software
- Harder to discover because smaller than regular aircraft

Civil UAV's





Marvin

Multi-purpose Aerial Robot Vehicles with Intelligent Navigation

- Developed by TU Berlin
- Won the Millennial Event at HAMMER 2000
- Equipment can be changed for different operations

Carolo T200



- Meteorological Mini-UAV (M²AV)
- Cooperation between TU Braunschweig & British Antarctic Survey
- 2007-2008 first successful measurement in the antarctica



- Only launch and landing are remote controlled, flight routes are set by computer
- Endurance about 45 minutes
- Range about 50 kilometers, area 15-300 meter, makes 100 measures/sec

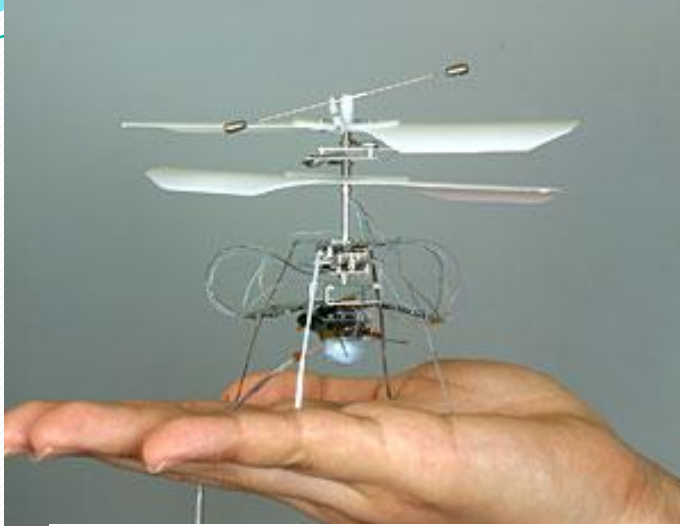
EMRoS

Epson Micro Robot System

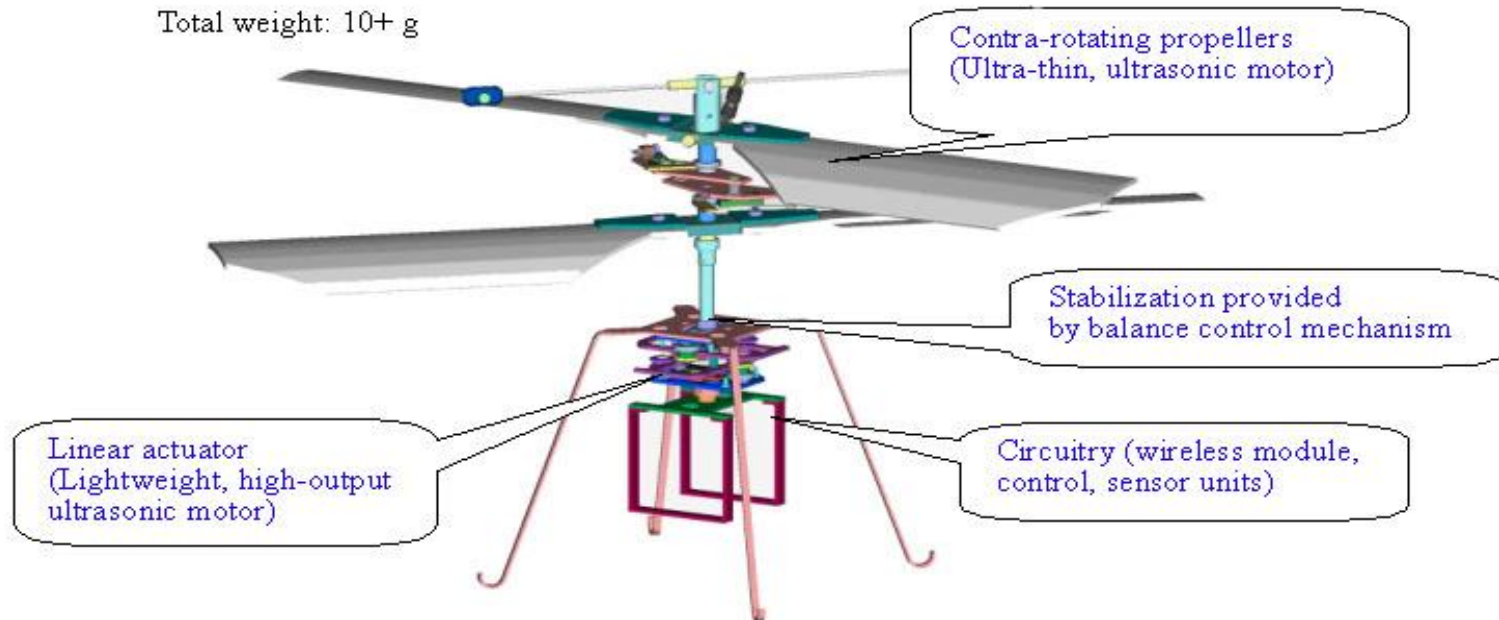
- Family of four models: Monsieur (1 cm³, is listed in the Guinness Book of Records), Nino (0.5cm³), Ricordo (1 cm³) and Rubie (1 cm³)

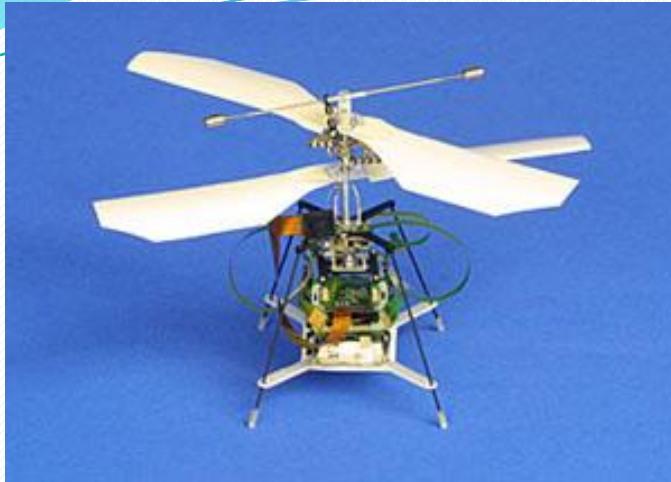


Epson Develops World's Smallest Flying Microrobot



Total weight: 10+ g





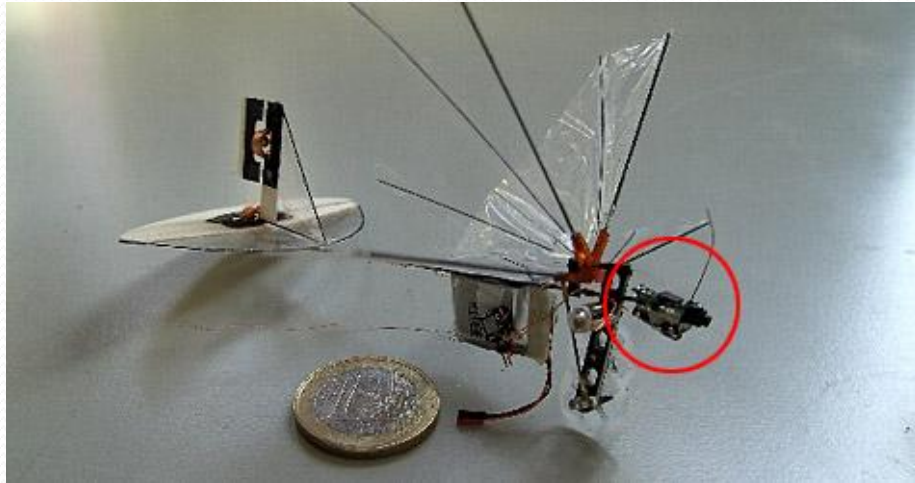
Epson Announces Advanced Model of the World's Lightest Micro- Flying Robot





COM-BAT Center for Objective Microelectronics and Biomimetric Advanced Technology

- Spyrobot in development from U.S army
- The goal is to copy the echolocation of a bat
- Possible equipment: mini-microphones, detectors for radiation or toxic gas
- Tactical reconnaissance for house-to-house fighting



DelFly Micro

- Size 10 centimeter, carries a camera with range about 50 meter(red circle)
- Not yet autonomously, but can fly lines and turns
- The follower DelFly Nano shall be 5 centimeter

Military UAV's



RQ-1 Predator



- Predator (dt. "Raubtier")
- „R“ for reconnaissance
- „Q“ for unmanned aircraft system
- First Flight: April 1995
- TV-Cameras, IR-Cameras and Radar.
- 119 hp (89 kW) piston engine
- Price: 40.000.000 US-\$ (1997)
- Remote Controlled
- Returns autonomously back to airbase on loss of connection

MQ-1 Predator



- MALE
- 2 AGM-114 Hellfire Rockets
(Air-to-Ground) or AIM-92 Stinger (Air-to-Air)
- Armed with weapons to shorten times between recognition of a target and the following air strike
- Especially to target Osama bin Laden and members of the Al-Qaida
- In 2002 one MQ-1 was shot down by an Iraqi MiG-25

MQ-1 Predator Specifications

General characteristics

Crew: 2 (one pilot and one sensor operator)

Length: 27 ft (8.22 m)

Wingspan: 48.7 ft (14.8 m (dependent on block of aircraft))

Height: 6.9 ft (2.1 m)

Wing area: 123.3 sq ft (11.5 m²)

Empty weight: 1,130 lb (512 kg)

Loaded weight: 2,250 lb (1,020 kg)

Max takeoff weight: 2,250 lb (1,020 kg)

Powerplant: 1× Rotax 914F turbocharged Four-cylinder engine, 115 hp (86 kW)

Performance

Maximum speed: 135 mph (117 knots, 217 km/h)

Cruise speed: 81–103 mph (70–90 knots, 130–165 km/h)

Stall speed: 62 mph (54 knots (dependent on weight of aircraft), 100 km/h)

Range: 400 nmi (454 mi, 726 km)

Service ceiling 25,000 ft (7,620 m)

Armament

2 hard points

2 × AGM-114 Hellfire (MQ-1B)

2 × AIM-92 Stinger (unknown number) (MQ-1B)

MQ-9 Reaper

- First flight:
2 February 2001
- The Reaper can carry
15 times more ordnance
and cruise at three times the speed of the MQ-1
- Price: 12.325 million US-\$



MQ-9 Reaper

- With an operational ceiling of 50,000ft, and higher cruising speed, Reaper can cover a larger area, under all weather conditions carrying payloads of more than 1.5 tons. The aircraft is powered by a single Honeywell TP331-10 engine, producing 950 shp, provides a maximum airspeed of 260 kts and a cruise speed for maximum endurance of 150-170 kts.



MQ-9 Reaper Specifications

GENERAL CHARACTERISTICS

Contractor: General Atomics Aeronautical Systems Incorporated

Crew(remote): 2 (Pilot plus a sensor operator)

Landing Type: runway

Launch Type: runway

Power Plant: Honeywell TP331-10T turboprop engine, 950 SHP (712 kW)

Fuel Capacity: 1815 kg (4,000 lb)

Length: 11 m (36 ft)

Wingspan: 20 m (66 ft)

Empty weight: 2223 kg (4,900 lb)

Max takeoff weight: 4760 kg (10,500 lb)

PERFORMANCE

Service ceiling: 15 km (50,000 ft)

Operational altitude: 7.5 km (25,000 ft)

Endurance: 14-28 hours (14 hours fully loaded)

Range: 5,926 km (3,200 nmi, 3,682 mi)

Payload: 3,750 lb (1,700 kg)

Maximum speed: 482 km/h (300 mph, 260 knots)

Cruise speed: 276-313 km/h (172-195 mph, 150-170 knots)

ARMAMENT

6 Hardpoints

- 1,500 lb (680 kg) on the two inboard weapons stations
- 500–600 lb (230–270 kg) on the two middle stations
- 150–200 lb (68–91 kg) on the outboard stations

Up to 14x AGM-114 Hellfire air to ground missiles can be carried or four Hellfire missiles and two 500 lb (230 kg) GBU-12 Paveway II laser-guided bombs. The ability to carry the JDAM in the future is also possible, as well as the AIM-9 Sidewinder.

SENSORS

AN/APY-8 Lynx II radar

MTS-B

COST

Unit cost: USD 13.325 million for one aircraft with sensors (2006 dollars)

RQ-4 Global Hawk

- HALE
- It can survey as much as 40,000 square miles (100,000 km²) of terrain a day
- 123.2 million US-\$ per aircraft
- Germany ordered 5 EuroHawks for 860€ million (delivered until 2010)



RQ-4 Global Hawk Specifications

General characteristics

Crew: 0

Length: 44 ft 5 in (13.5 m)

Wingspan: 116 ft 2 in (35.4 m)

Height: 15 ft 2 in (4.6 m)

Empty weight: 8,490 lb (3,850 kg)

Gross weight: 22,900 lb (10,400 kg)

Powerplant: 1 × Allison Rolls-Royce AE3007H turbofan engine, 7,050 lbf (31.4 kN) each

Performance

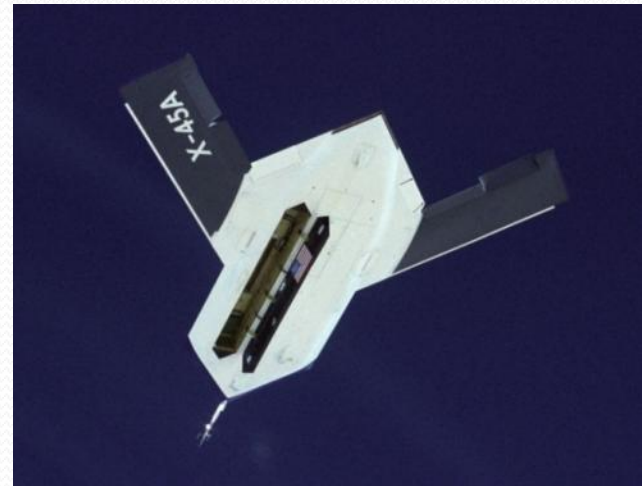
Cruise speed: 404 mph (650 km/h)

Endurance: 36 hours

Service ceiling: 65,000 ft (20,000 m)

Boeing X-45A

- UCAV
- Part of the J-UCAS Project of the DARPA
- First Flight: 22.05.2002
- Defensive Air-to-Air and Air-to-Ground Combat
- Half-autonomously, a pilot controls some operations via Remote Control and confirms attacks



Boeing X-45C



- Advancement of the X-45A
- Three times greater combat range
- Capable to transport 2 tons of bombs
- received \$767 million from DARPA in October, 2004
- Additional \$175 million for autonomous Aerial Refueling technology
- In March 2006 the US Air Force decided not to continue with the X-45 Project
- Boeing then submitted a proposal to the Navy for a carrier based version of the X-45, the X-45N

X-45 Specifications

	X-45A	X-45C
Type:	UCAV	UCAV
Length:	8,08 m	11,89 m
Wingspan:	10,23 m	14,90 m
Height:	1,15 m	2,14 m
Empty Weight:	3.628 kg	8.165 kg
Maximum Weight:	6.804 kg	16.555 kg
Maximum Airspeed:	ca. Mach 1	ca. Mach 1
Cruise Speed:	ca. Mach 0,85	ca. Mach 0,85
Service ceiling:	<i>unknown</i>	12.190 m
Combat range:	ca. 1.200 km	2.220 km
Armament:	900 kg bombs in two bays	2.041 kg bombs in one bay
Engine:	Allied Signal F124-GA-100-Turbofan	General Electric F404-GE-102D-Turbofan
Thrust:	27,96 kN	50,03 kN

Small sized UAV's



CU-167 Silver Fox

The Silver Fox can be used for:

- Chemical/Oil pipeline surveillance
- Radiation contamination detection
- Air pollution monitoring
- Meteorological missions
- Large facility security
- Forestry/Agriculture/Ranching surveillance
- Waterways monitoring
- Criminal apprehension
- Academic research



Phantom Sentinel

Features:

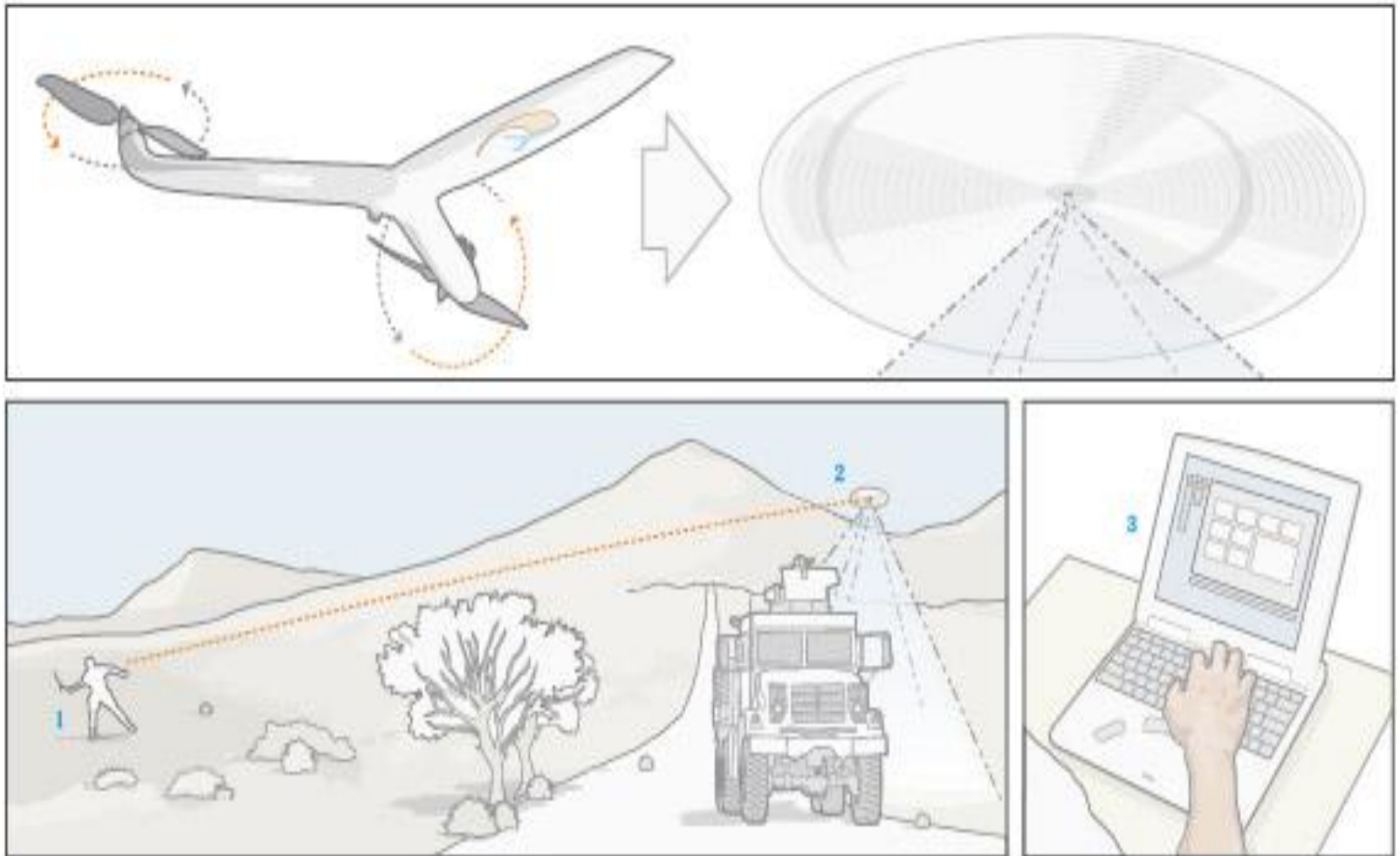
- Near invisible surveillance for close in intelligence
- Scalable in size/range
- Self Leveling in flight
- RC or GPS compatible
- 360 degree spherical viewing available from high speed camera

Characteristics:

- DC electric power
- Collapsible wing allows The Phantom to easily fold into a 12 X 6 X 4 inch space



Phantom Sentinel



ScanEagle

- ScanEagle has a stabilized camera turret, designed to track an object of interest for extended periods of time, even when the aircraft nose is seldom pointed at the object. The turret can house either an electro-optical daylight or infrared camera.
- 20+ Hours of Endurance Both Day and Night
- High Level of Stealth even at Low Altitudes
- Endurance 20+ hours
- Max Level Speed 70 knots / 36 m/s



Wasp III (BATMAV) Micro UAV

- *Wasp* is a hand-launched, recoverable flying-wing UAV, which uses synthetic materials that act both as a battery and as main wing structure. It is waterproof, and is recovered automatically by a horizontal landing on land or water. The UAV can fly for up to an hour, and is equipped with a GPS-based navigation system for fully autonomous missions.

Specifications:

- 13 cm long,
- Span of 33 cm
- Weighed 170 g



AFRL BATCAM

- The UAV weighs less than 400 grams, and vehicles of this class are planned to replace current systems, which have similar capabilities but weigh several kilograms.

Specifications:

- Length 61 cm
- Wingspan 53 cm
- Weight 0.38 kg
- Endurance 18 min
- Propulsion Electric motor
- Range 3 km (1.6 nm)
- Ceiling 300 m (1000 ft)



Tritons Frisbee UAV

- The circular drones will be launched "from munitions dispensers or by means of a simple mechanism similar to a shotgun target (skeet) launcher," Triton adds. Once in the air, they'll be tele-operated by soldiers on the ground. Or, if needed, the fightin' frisbees will pilot themselves as they hunt for guerrillas.
- Once they catch up to the baddies, the drones will use a series of armor-piercing explosives, shooting jets of molten metal, to eliminate their targets. And these MEFP [Multiple Explosively Formed Penetrator] "warheads will be controllable so as to provide a single large fragment (bunker-buster) or tailorable pattern of smaller fragments (unprotected infantry or light utility vehicles).



Middle sized UAV's



Alenia Sky-X UCAV

- Alenia Sky-X UCAV is powered by a single jet engine, is capable of speeds up to 440 knots, can climb above 30,000 ft and perform high-g maneuvers.



CQ-10 Snowgoose

- SnowGoose are designed in such a way that the user can easily trade cargo capacity for more endurance and vice versa. An industry standard laptop computer is used to program the flight plan and upload it into the UAV's guidance system before launch.
- The SnowGoose conducts its mission completely autonomously, and can be programmed to either land at its destination point or drop supplies from the air and return to base.

Specifications

- Length 2.90 m
- Weight max: 635 kg; empty: 270 kg
- Cargo weight max: 272 kg



Mirsad 1

Specifications (approximate)

- Length: 2.90 m
- Wingspan: 3.00 m
- Powerplant: 1 piston engine, 8 kW
- Maximum speed: 120 km/h
- Service ceiling: 2,000 m
- Armament up to 50 kg of explosives



Sperwer B

- Sperwer unmanned aerial system (UAS) is designed to support Intelligence, Surveillance, Target Acquisition and reconnaissance (ISTAR) at the battlegroup level (brigade to division).
- The system supports simultaneous control of two aircraft, from a single GCS. Furthermore, several GCSs can control multiple missions, and can hand-over UAVs between each other. The ground station is provided with advanced mission planning tools, including 3D terrain modeling and flight path presentation on a geographical data system, image processing, interpretation and connection to C4I networks and compatibility with NATO datalinks and communications networks.



X-50A Dragonfly

- The X-50A is powered by a single conventional turbofan engine. For rotary-wing mode, the engine's exhaust is diverted to nozzles in the tips of the rotor blades. When the aircraft transitions to full forward flight, the engine exhaust is directed through a nozzle at the rear of the aircraft and the rotor is locked into a fixed position and functions as a conventional wing.



Navmar XPV-2 Mako

Specifications:

- Length 3.02 m
- Wingspan 3.86 m
- Weight 64 kg
- Speed max: 130 km/h
- Cruise: 83 km/h
- Ceiling 3000 m
- Range 75 km
- Endurance > 7 h
- Propulsion 3W
- Piston engine; 7.8 kW
- 30 UAVs were successfully used during Operation Iraqi Freedom.



Big sized UAV's



BAE Corax UCAV (Raven)

- The **Corax**, also known as **Raven** is a prototype UAV for the British Air Forces being developed by BAE Systems. Its first test flight was in 2004 after a ten month development cycle. It was first unveiled to the public in January 2006.
- Corax, which uses stealth technology, is part of a programme to develop pilotless combat vehicles for future warfare.



Dassault nEUROn

Dimensions

- Length: 10m
- Wingspan: 12.5m
- Empty Weight: 4,500kg
- Weight: With Full Payload 6,000kg
- Engines: 2
- Endurance: Unspecified, but expected to be several hours
- Speed: Mach 0.7 to mach 0.8



EADS Barracuda

- Barracuda is the project under development by EADS.
- The aircraft is a joint venture between Germany and Spain

Specifications:

- Length: 8.25 m
- Wingspan: 7.22 m
- Empty weight: 2300 kg
- Max takeoff weight: 3250 kg
- Maximum Speed: 0.85 mach



Hermes 450

- Hermes 450 was selected by the Israeli and British forces to provide Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) services. In Israeli Hermes 450 is in operational use for about 10 years. Hermes 450 has already accumulated over 20,000 operational flight hours, mostly in combat service with the IDF, where it is used as the primary battlefield reconnaissance platform.



Heron or Machatz-1

- The **Heron** was developed by the Malat (UAV) division of Israel Airforce Industries. It is capable of Medium Altitude Long Endurance (MALE) operations of up to 52 hours' duration at up to 35,000 feet. It has demonstrated 52 hours of continuous flight, but the effective operational maximal flight duration is less, due to payload and flight profile.



MQ-5A Hunter

Specifications:

- Primary Function: division- and corp-level reconnaissance
- Contractor: TRW Israel Aircraft Industries
- Power Plant: 2 Moto-Guzzi twin cylinder, 4 stroke engines
- Length: 7 m
- Weight: 727 kg
- Wingspan: 8.9 m
- Range: 11.6 hours at 260 km (144 nautical miles)
- Ceiling: 4600 m
- Payload: 90 kg



MQ-5B Hunter

- Northrop Grumman Corporation's (NYSE:NOC) Hunter Unmanned Aircraft System (UAS), in use with the U.S. Army since 1996, recently surpassed 50,000 flight hours in service, over half of which were flown in combat over Iraq and the former Yugoslavia.

Latest News:

- U.S. Drone MQ-5B Hunter Kills 3 In Pakistan
- <http://www.cbsnews.com/stories/2009/01/01/world/main4695184.shtml>



RQ-5 Hunter

- Primary Function: division- and corp-level reconnaissance
- Contractor: TRW, Israel Aircraft Industries
- Power Plant: 2 Moto-Guzzo twin cylinder, 4 stroke engines
- Length: 7 m
- Weight: 727 kg
- Wingspan: 8.9 m
- Speed: Range: 11.6 hours at 260 km
- Ceiling: 4600 m
- Fuel Capacity: Payload: 90 kg



Lockheed Martin Polecat

- The Polecat unmanned aerial vehicle (UAV) is a 28-metre flying wing, weighing four tones.
- Specifications:
- Capacity: 454 kg of weapons or sensors
- Wingspan: 27.44 m
- Loaded weight: 4,090 kg
- Powerplant: 2× Williams International FJ44-3E turbofans, 3,000 lbf (13.38 kN) each
- Service ceiling 19,817 m
- Endurance: 4 hours



X-47B UCAS

- The X-47B is a transformational, carrier-capable, multi-mission, unmanned combat air vehicle.
- Strike fighter-sized, it is a survivable, long range, high endurance and persistent platform capable of a variety of missions including Intelligence, Surveillance and Reconnaissance, and Time Sensitive Targeting/Strike.



Helicopter Drones



A160T Hummingbird

- The A160 joined Boeing's line of UAVs in May 2004 with the acquisition of Frontier Systems Inc., at Irvine, Calif. The aircraft's unique characteristics address current and emerging requirements of the U.S. armed forces, the U.S. Department of Homeland Security, and international military and security organizations.



MQ-8 Fire Scout

- The RQ-8A is based on the Schweizer Model 330SP manned light helicopter. It is powered by a derated Rolls-Royce/Allison 250-C20W turboshaft engine which drives a three-bladed rotor. The blades can be folded for compact stowage of the UAV. The *Fire Scout* is equipped with a GPS-based navigation system for autonomous operations, and the GCS (Ground Control Station) can control three UAVs simultaneously. The line-of-sight range of the Ku-Band TCDL (Tactical Common Datalink) is about 280 km (150 nm). The payload for the reconnaissance and targeting mission is an integrated Northrop Grumman EO/IR/LDRF (Electro-Optical/Infrared/Laser Designator & Rangefinder) system.



Missiles



Spike ER

- Spike is a fire-and-forget missile with lock-on before launch and automatic self-guidance. The missile is equipped with an imaging infrared seeker. The long, extended and medium range versions of the Spike also has the capability of Fire, Observe and Update operating mode, by the use of fiber-optical wire that is spooled between the launch position and the missile. This allows the operator to lock onto a target if the target is not in the line of sight of the operator, switch targets, or compensate for the movement of the target if the missile is not tracking the target for some reason. Furthermore, the missile could also be used for simple observation on the other side of the hill and maybe engage a target of opportunity.



U-ADD

- Universal Aerial Delivery Dispenser / Textron Systems
- A mission configurable payload Universal Aerial Delivery Dispenser (U-ADD) is developed by Textron Systems to be used for aircraft and UAV precision delivery of ordnance and special payloads. The U-ADD dispenser uses GPS guidance to precisely deploy various types of air delivered cargo to a specific point, using four-fin guided tail kit with active fin control and parachute, when soft delivery is required. Potential cargo could include 100 lbs (45 kg) of critical supplies such as ammunition, batteries and medical supplies, chaff, sonobouys or unattended ground sensors (UGS) leaflets or lethal munitions. U-ADD can also accommodate a single CLAW weapons, for enhanced area effect.



On Ground UGV's



Boston Dynamics BigDog

- BigDog is 1 metre (3.3 ft) long, stands 0.7 metres (2.3 ft) tall, and weighs 75 kilograms (170 lb), about the size of a small mule. It is capable of traversing difficult terrain at 5.3 kilometres per hour (3.3 mph), carry 154 kilograms (340 lb) and climb a 35 degree incline. The Locomotion is controlled by an onboard computer that receives input from the robot's various sensors. Navigation and balance are also managed by the control system.



BomBot

- The BomBot is a remote-controlled robot that is being used for military purposes such as inspecting improvised explosive devices.
- Video:
<http://videos.howstuffworks.com/technology-evangelist/2435-bombot-the-military-robot-video.htm>



Crusher UGV

- Crusher navigates between two GPS waypoints and uses advanced sensors to detect the best route to get there.
- UPI: UGCV Preceptor Integration
- Video:
<http://www.videosift.com/video/DARPA-Military-Robot-UGV-Crusher-2>
- <http://technorati.com/videos/youtube.com%2Fwatch%3Fv%3D562yb0wifPo>



Deep Digger

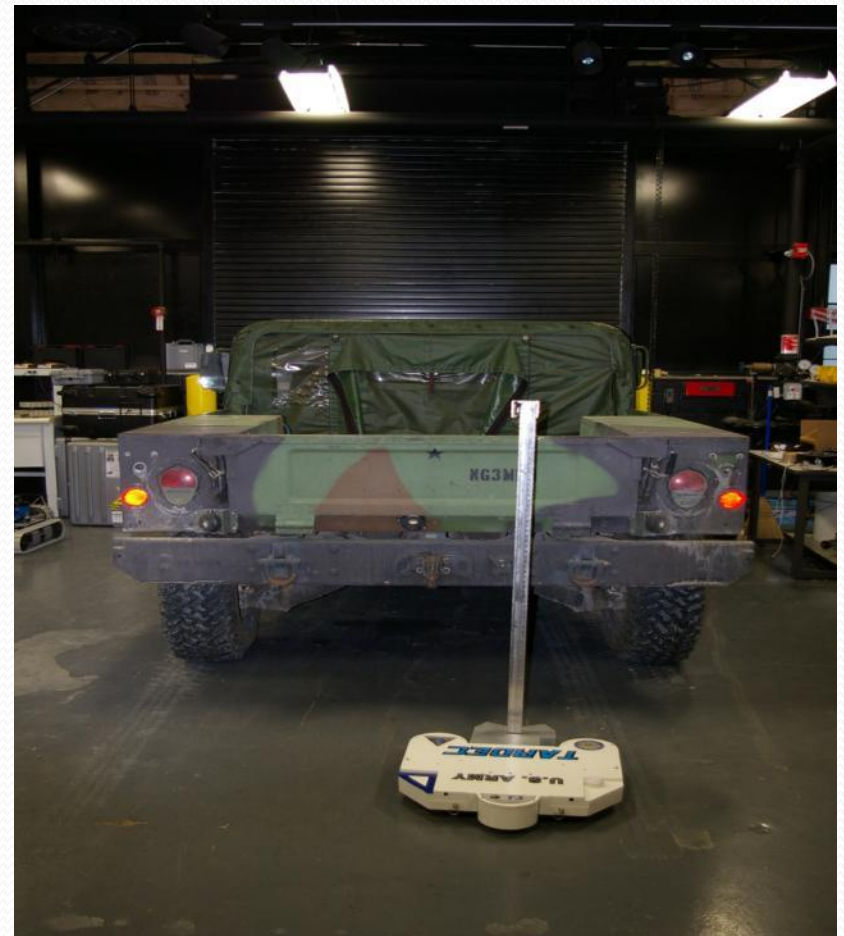
New Bomb Drills for Bunkers

- Deep Digger uses cannon to tunnel through solid rock, drilling a channel for the bomb.



ODIS

- The U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) and Utah State University (USU) have developed a tele-operated robot called ODIS (Omnidirectional Inspection System) that is particularly effective in performing under-vehicle inspections at security checkpoints.

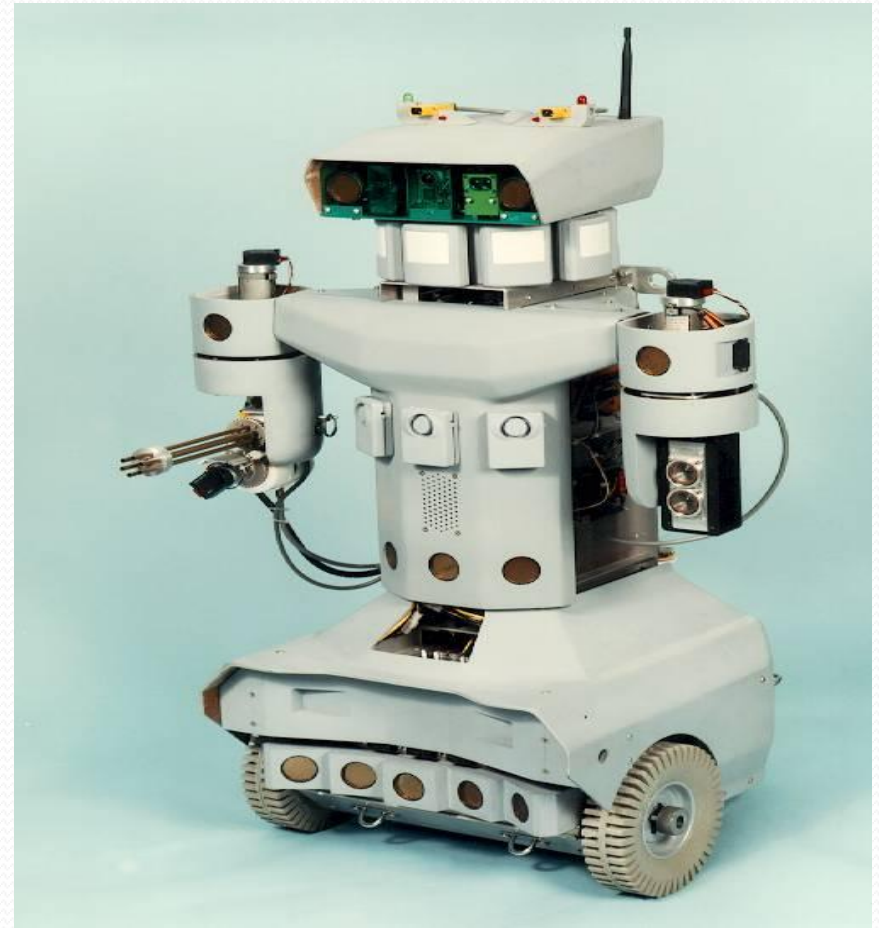


ROBART III

- ROBART III is strictly a laboratory prototype, never intended for fielding in the real-world:

Disadvantages

- 1) it is not waterproof,
- 2) its mobility is constrained to planar floor surfaces, so it can't ascend or descend stairs,
- 3) It is not defensively armored,
- 4) It is not rugged, and,
- 5) it cannot self right in the event it flips over.



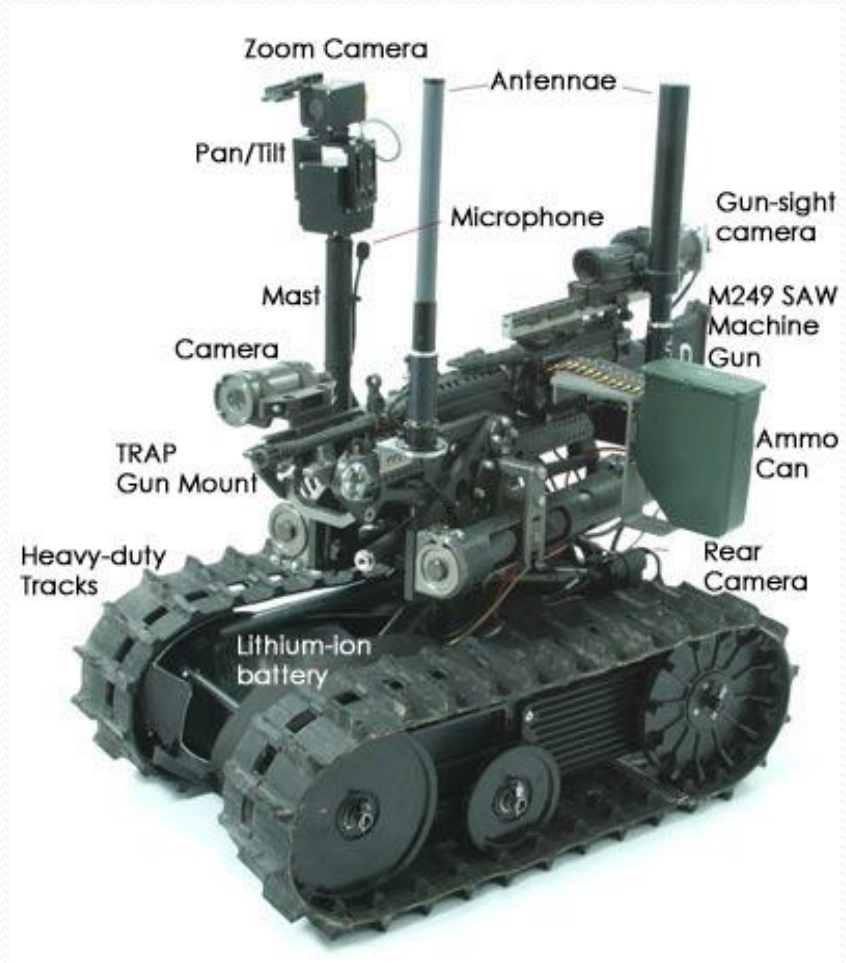
RoboScout

- The German Federal Armed Forces are experimenting with a prototype, satellite-controlled that can go on recon missions
- The satellite link, which can transmit video at 2 Mbps and receive control channel data up to 128 Kbps.



Talon Robot

- At about 52 kg TALON can be easily transported and is instantly ready for operation.
- TALON robots can take a punch and stay in the fight. One was blown off the roof of a Humvee in Iraq while the Humvee was crossing a bridge over a river. TALON flew off the bridge and plunged into the river below. Soldiers later used its operator control unit to drive the robot back out of the river and up onto the bank so they could retrieve it.
- Video: http://www.foster-miller.com/images/Videos/destroyed_robot.wmv



Long Gun Guardium UGV

- Designed mostly for border patrol and recon missions, the Guardium's onboard telemetry can receive GPS coordinates for adapting its pre-programmed routes on the fly and avoid obstacles on its own.
- Video:
http://www.gizmodo.com.au/2008/08/autonomous_guardium_ugv_buggy_tirelessly_patrols_danger_zones_so_you_dont_have_to-2.html



On/Under Water



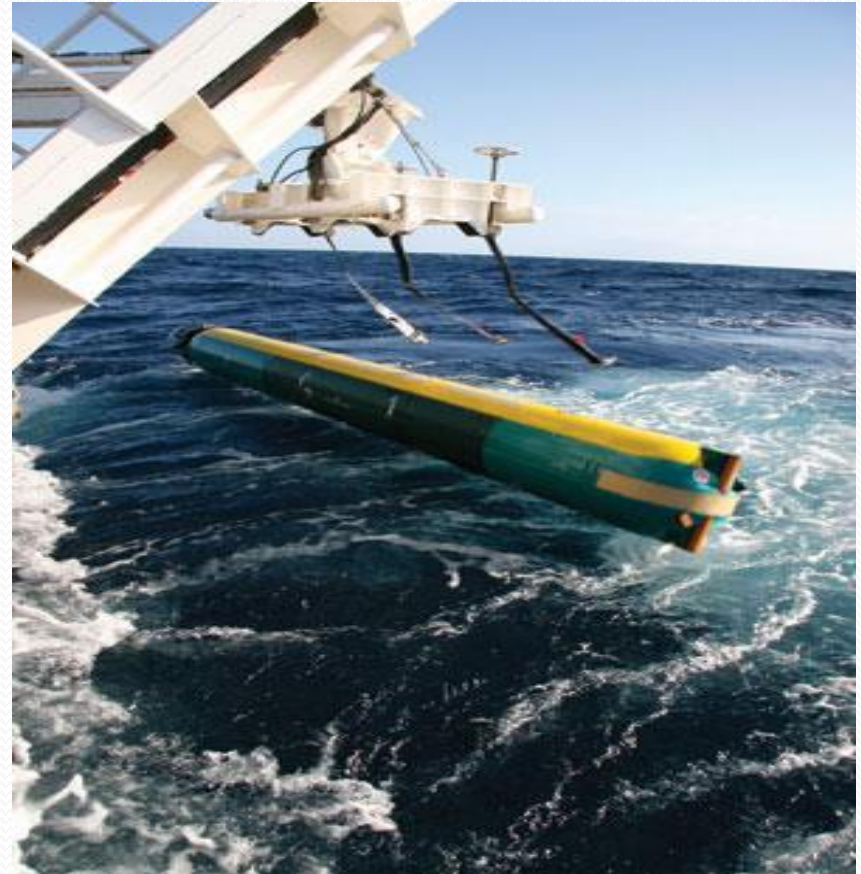
NAVOCEANO Seahorse

- SEAHORSE construction is modular to facilitate field maintenance, rapid mission turnaround, and payload flexibility. With an integrated afterbody for propulsion and hydrodynamic control, plus variable ballast systems fore and aft, the UUV can execute a variety of high-level commands, such as maintaining a constant depth, course, and speed; navigating between waypoints; and conducting search and survey patterns. Typical mission operating depths range from 15 to 1,000 feet, with endurance up to 72 hours. SEAHORSE vehicles are 28 feet long, slightly more than three feet in diameter, and weigh 10,500 pounds. Standard alkaline batteries (D-cells) power the vehicle, allowing a 300-mile range.



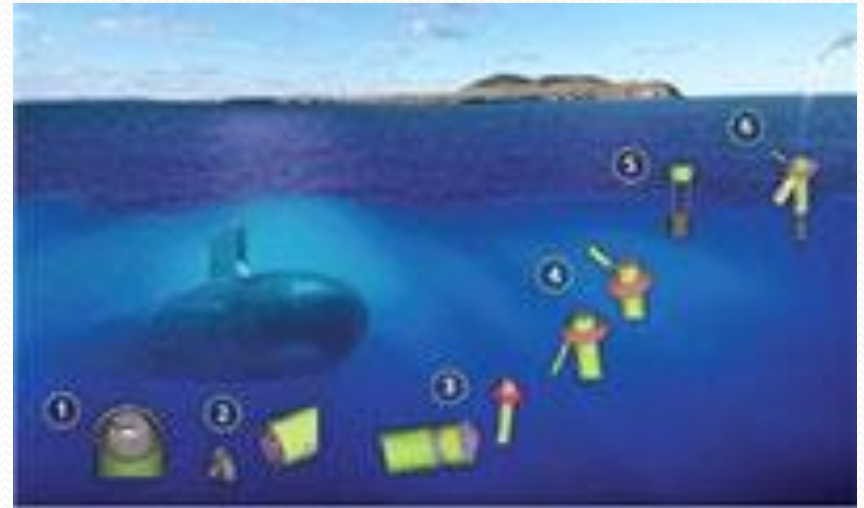
BLQ-11 LMRS

- The AN/BLQ-11 is a long-term mine reconnaissance system designed to be deployed from nuclear-powered attack submarines such as Los Angeles class. The BLQ-11 is being developed by Boeing on behalf of the US Navy. A single system comprises a 60-ft (approx. 20 meters) robotic arm, two unmanned underwater vehicles (UUVs), shipboard deployed equipment and non-deployed shore support equipment. The BLQ-11 UUV is launched out of the submarine through a torpedo tube and recovered docking with the robotic arm which takes care of getting it back through the launch torpedo tube.



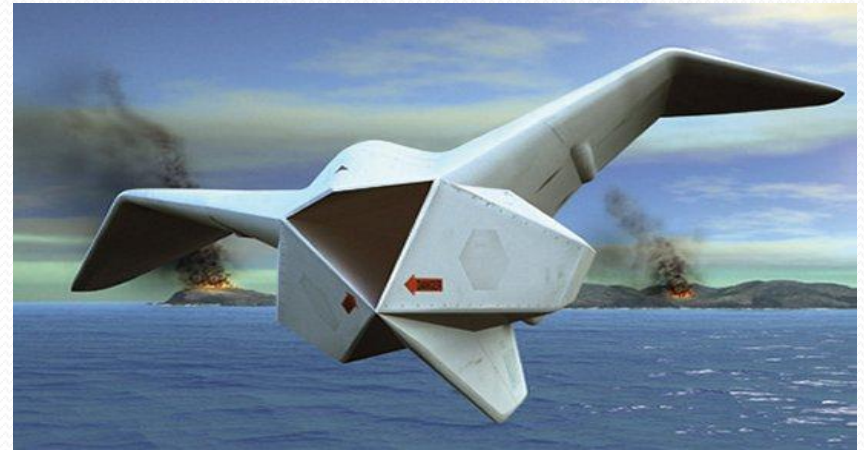
Raytheon

- Raytheon plans to launch a small unmanned air vehicle from a submerged U.S. Navy submarine



Cormorant

- Lockheed Martin is developing an unmanned aircraft that can be released from the ballistic missile tube of a Trident Submarine -- 150 feet underwater. Floating to the surface, its wings unfold, booster rockets fire, and it is airborne.
- Called the Cormorant, this jet-powered autonomous aircraft could act as a spy plane or deliver firepower in a surgical strike. When the mission is over, the Cormorant receives computer signals from the submarine that can direct it to a rendezvous point.
- Landing back in the sea, a tether is connected to the Cormorant by a robotic underwater vehicle and the aircraft can be reeled in to the submarine that is loitering just below the surface.



DRS RQ-15 Neptune

- The RQ-15A is a mini-UAV powered by a small piston engine. The UAV design is optimized for water landings, using a high-mounted engine and payload bays protected from water intrusion. Over land, the *Neptune* can be recovered with a conventional landing or by parachute. The UAV is equipped with a GPS waypoint navigation system for autonomous operation, and a two-way UHF datalink for remote control and sensor data transmission. The datalink is also optimized for over-water operations, having provisions to cope with multiple signal paths caused by water reflections. The operator uses a computer terminal for mission planning, in-flight mission update, sensor management and real-time data observation. The payload is either a color camera or a thermal imaging device.



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