



# REALITYVISION

## UNMANNED VEHICLE PILOT SYSTEMS

*... where human talents cannot be replicated by a machine*



RV-02 UADP UAV Demonstrator



GCCS Technology Demonstrator V1.1

Driven by  
**CAN**  
Aerospace

### - TECHNOLOGY DESCRIPTION v2.1b -



## UVMS - UNMANNED VEHICLE MANAGEMENT SYSTEM

RealityVISION is one of the most innovative and powerful next-generation **Unmanned Vehicle Management System (UVMS)** that provides integrated flight, payload and propulsion control. The UVMS enables the pilot to aggressively and safely maneuver the UAV to its maximum capabilities in the pilot-in-the-loop command and control mode.

The system fitted with advanced technology driven by the NASA standardized **CANAerospace command and control protocol** includes hardware, such as the cyclic control stick and throttle (HOTAS), rudder pedals, air data probes and the primary flight control computer. The UVMS also encompasses the software and Graphic User Interfaces (GUI) that controls these devices.

The RealityVISION cockpit is one of the very first **“all-glass” cockpits** for tactical, combat and civil defense UAVs - there are no traditional round dial, standby or dedicated gauges. It is the first baseline “night vision module” and “3D-synthetic vision” compatible system, and it has designed in growth capability for Head Mounted Displays (HMD) with head-tracker interoperability.

RealityVISION - Unmanned Vehicle Pilot System; get out the **maximum performance** from your UAV.



## GCCS - GROUND COMMAND & CONTROL SYSTEM

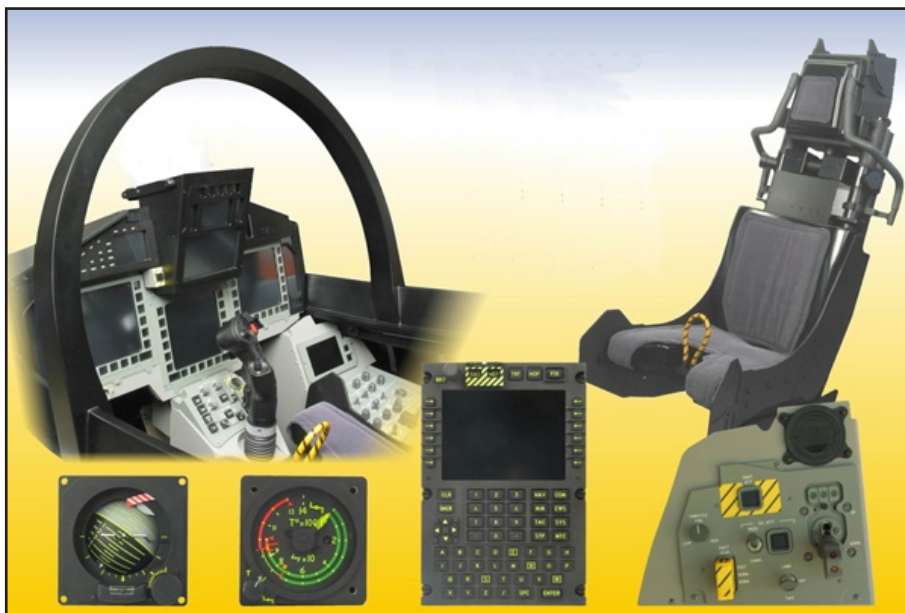
The Ground Command & Control System (GCCS) comprises a family of Multi Function Consoles ranging from rugged man-portable units to less rugged for ground vehicle operations. The GCCS is specifically designed to manage command & control and payload sensors of fixed-wing and rotary-wing (VTOL) unmanned vehicles.

To avoid reinventing the wheel, RealityVISION was developed based on the studies of **last generation fighter cockpits** such as Rafale, F-22, F-35 and the Typhoon. The result of this is a highly automated modular cockpit giving the pilot the correct information as and when required with little external prompting. All cockpit relevant information is processed by the single modules based on the CANaerospace command and control protocol.

The hardware core of RealityVISION is based

on the NECS computer systems. The **Network Extended Control System (NECS)** is a family of ruggedized, modular computer systems providing numerous real world interfaces and 32-bit computing power. Up to 200 Network Extended Control System units may communicate with each other (or with workstations, PCs or VME boards) by means of the object oriented, **1MBit/s Controller Area Network bus (CAN-Bus)**. The standard communication protocol used within NECS-based systems is CANaerospace.

RealityVISION is the very first "nativ CANaerospace" environment for UAV/UCAV applications that includes the avionic part as well as the ground cockpit modules. CANaerospace is also known as the **NASA AGATE Databus Standard**.



PowerVCIS for Tactical and Airship UAVs



# VCIS - VEHICLE CONTROL & INFORMATION SYSTEM

## Hands On Throttle And Stick - HOTAS

A centrally mounted two axis displacement cyclic control stick assembly is utilised with a side mounted throttle, both HOTAS enabled. HOTAS enhances the situation even further by incorporating **24 programmable buttons** on the throttle and stick. These buttons would be programmed to carry functions relating on both civil and military applications, e.g. switching of auto-pilot modes, FLIR/EO camera control, flaps and air-brake control, weapon or payload trigger, display switching, etc.

As well as pilot orientated functions the HOTAS also incorporates the pilot and payload camera **audio/video recording facilities** using a digital recording unit.



## Multi Function Display - MFD

Each of up to three Multi-Function Displays (MFD) offers a backlitged 320x256 pixel resolution graphic color LCD and allows to control and monitor the EFCS and display data online. Surrounding each display will be **8 soft-touch programmable function buttons** enabling access to different display configurations and systems.

Each of the MFDs can be used to outputting data from a number of systems, including Systems informations, Primary Flight Display Informations, Engine Informations, Moving Map Display, System Alerts, Faults and Status, etc.





## UAV/UCAV Simulator

RealityVISION have a unique reconfigurable feature. It can be employed as a UAV/UCAV flight simulator as well. The ability to use the same equipment allows the pilots to trainee and pilot the UAV/UCAV on the same GCS platform. This is a great ROI (Return On Investment) for both civil and military applications.

The flight simulation software employed by RealityVISION to explore potential flight-test problems, and pilot and mission training is X-Plane v8 by Laminar Research.

X-Plane is the world's most comprehensive, powerful flight simulator software, and has the most realistic flight model available for COTS computers. X-Plane's accuracy (in flight model), scope (in aircraft and terrain coverage), versatility (in aircraft type and weather conditions), add-on programs (in aircraft and scenery editors), user-customizability, downloadable aircraft, and downloadable scenery makes it the high quality, but COTS cost flight simulation solution for UAV/UCAV platforms for civil and military applications. X-Plane's flight model can handle flying wings and fly-by-wire systems, as needed for a UAV/UCAV simulation.

## How it Works

X-Plane reads in the geometric shape of any aircraft and then figures out how that aircraft will fly. It does this by an engineering process called "blade element theory", which involves breaking the aircraft down into many small elements and then finding the forces on each

little element many times per second. These forces are then converted into accelerations which are then integrated to velocities and positions.

## Weather

Weather is variable from clear skies and high visibility to thunderstorms with controllable wind, wind shear, turbulence, and microbursts! Rain, snow and clouds are available for an instrument flying challenge, and thermals are available for the UAV gliders! Real weather conditions can be downloaded from the internet, allowing you to fly in the actual weather that currently exists.

## Scenery

With the included scenery, you can land at any of over 18,000 airports, as well as test your mettle on aircraft carriers, helipads on building tops, frigates that pitch and roll in the waves, and oil rigs. X-Plane also comes with Plane-Maker (to create your own airplanes), World-Maker (to create/update your own airports & scenery), and Weather Briefer (to analyze real weather conditions downloaded from the net).

## Failure Modes

X-Plane also has detailed failure-modeling, with systems that can be failed manually or randomly, when you least expect it! You can fail instruments, engines, flight controls, and landing gear at any moment.



## DARVIN A3 - ADVANCED AVIONIC ARCHITECTURE

As with any modern Unmanned Air Systems RealityVISION is reliant on many systems for flight. Of greatest importance here is the **Flight Control System**. However are several other systems of note including utilities and navigation systems as well as the integrated health monitoring system.

### Electronic Flight Control System - EFCS

The design of modern Unmanned Air Systems is such that without input to any control surface the air system will pitch up, down, roll or yaw during flight. This requires a system to enable controlled flight to be maintained and is achieved through the Fly By Wire (FBW) Electronic Flight Control System (EFCS) **DARVIN A3**. With this system all movements of the throttle, stick or pedals are interpreted by the EFCS and an appropriate control response taken.

The **DARVIN A3 - Advanced Avionic Architecture** is a family of a new generation, affordable, compact and ruggedized modular avionic system specifically designed for small,

high-performance **fixed-wing** and **rotary-wing (VTOL) UAV** applications, driven by the CANaerospace command & control protocol. The DARVIN A3 single-tasking operating system was designed for maximum reliability and follows the recommendations of the **RTCA DO-178B** standard for safety critical applications in airborne applications.

DARVIN A3 family of avionic modules are composed primarily of the **32-bit programmable** Digital Flight Control and Vehicle Management Subsystems, and provides integrated system solutions for Unmanned Air Systems, including flight control actuation, electric & engine power management and air data systems. Sharing the same core computing and I/O design, DARVIN A3 products are designed to **operate in harsh environments** and can be qualified to highest standards. Both the **DFCSnano** and **PowerDFCS** Digital Flight Control Systems are equipped with a range of CANaerospace driven subavionic sensor technologies to meet the specific requirements of a wide variety of applications, and to be open to future enhancements.



## DARVIN A3 - ADVANCED AVIONIC ARCHITECTURE

### Primary Flight Control Computer - PFCC

The Primary Flight Control Computer runs the control algorithms for the **primary flight control surfaces**, including flaps, ailerons, elevators, and rudders. The primary flight control computer takes pilot inputs via the control stick and current flight conditions from a number of **external and internal parameters** such as static and pitot air pressure and temperature (via the Air Data Transducers) as well as the aircraft's pitch, yaw, roll and velocity to calculate the desired airplane response. That desired response is fed to the primary flight controls as an output of the airplane's current control laws. The primary flight control computer outputs position the flight control surface actuators via servos, and the desired aircraft response is achieved. **System redundancy** is provided by using primary and backup battery source and up two channel FCS control over the flight control functions.

As well as providing what may be thought of as "direct flight control" or "pilot-in-the-loop" the DARVIN A3 also provides for **automation of flight**. The DARVIN A3 EFCS integrates an three-Axis **Autopilot (AP)** and a **Flight Director System (FDS)** that runs the Kalman filter guidance and navigation algorithms. Of course the typical function is a simple wings level and constant air speed holding. The DARVIN A3 EFCS however adds substantially to this thanks to the level of integration between systems. So in addition to the standard "auto-pilot" the DARVIN A3 incorporates the following other automates: **auto-throttle, auto-approach, auto-waypoint** and **auto-track**.

### Benefits of EFCS

One of the benefits of such a system is the ability to program the aircraft's **flight envelope characteristics** directly into the EFCS. This function called also Dual-Rate prevents the pilot from pushing the plane outside its stress/strain limits and allow more **easy manual handling** of the aircraft on high (e.g. combat tasks) or low velocities (e.g. landing tasks). In a similar way it is possible via the EFCS to compensate for external factors such as gusting which can suddenly lead to loss of aircraft control. A very useful function built into the RealityVISION is a single button push "**Return to Level**" feature. Upon pushing this button, the aircraft is automatically returned to nose-up, wings level flight with throttles set at an intermediate position.



## DARVIN A3 - ADVANCED AVIONIC ARCHITECTURE

### Navigation & Synthetic Vision

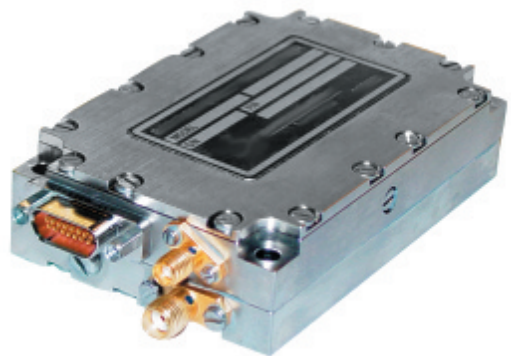
Any modern Unmanned Air System operating both **day and night and in all weathers** needs an accurate way to determine its position. To this end, RealityVISION contains several such systems to ensure an accurate position can always be calculated. The most common method for navigating Unmanned Air Systems relies on accelerometers and gyroscopes, so called **Inertial Navigation Systems (INS)**. In addition **Global Positioning System (GPS)** equipment is fitted enabling the aircraft to determine its position within several meters anywhere on the Earth. By cross referencing the INS with the GPS data it will be very hard to get lost an Unmanned Air System.

To prevent a RealityVISION pilot from having un-timed contact with the ground the EFCS is fitted with two additional systems. A **microwave or ultrasonic altimeter** provides highly accurate data on the Unmanned Air System's exact height above the ground. In addition the ground control station is fitted with the **Synthetic Vision System (SVS) SynthVISION3D** which provides digital terrain elevation maps of the Earth's surface. The SynthVISION3D software via continuous updates from the aircrafts INS, GPS and radar altimeter provides drift-free navigation. Perhaps more importantly SynthVISION3D can provide **automatic terrain following, terrain elevation prediction** with audible warning of the danger and all weather flying capabilities through the synthetic vision.

### Airborne Video & Data Link

The ground cockpit is real-time linked to the unmanned air system through a **CANaerospace Wireless Gateway** that support PCM, RS-232 and PPM communication.

As with any Unmanned Air System there is of course an essential requirement for **remote video, control and telemetry data link** equipment. RealityVISION features a S-Band high bandwidth full-duplex native **CANaerospace PCM** link or a S-Band low bandwidth half-duplex FM link. Both the data link systems can be simplex or duplex with redundancy and diversity features. Included in the Control/Telemetry Data Link System is an CANaerospace/PCM network capable **Intra-Flight Data Link (IFDL)** that allows all RealityVISION pilots to share flight data or pilot an Unmanned Air System online out from an manned aircraft while in the air. This link also allows additional RealityVISION flights to be added to the net for multi-flight coordinated attack or maneuvers.



## UCS - UTILITIES CONTROL SYSTEMS

In keeping with the level of integration present in the other RealityVISION systems the utilities components are also tightly combined and highly automated. The suite of utilities is combined under the Utilities Control Systems (UCS).

### Electric Power & Engine Management System - EPEMS

RealityVISION has essentially **two electrical systems**, the vehicle engine control and power distribution system and the ground cockpit power distribution unit. Using this electrical power on the vehicle and to the ground can be supplied at a number of voltages and DC output. The avionic DC system is a fully **redundant battery source** with a backup unit in case the primaries fail. Regulation, monitoring and control of the **fuel flow** is handled automatically by the ECPDU. The current remaining fuel can be graphically displayed via the **Management Control Data Unit (MCDU)** on the ground cockpit.

### Ground Power Distribution Unit - GPDU

The ground cockpit power distribution unit powers with 24V DC the CANaerospace bus and is a **4U standard card cage** unit. It also incorporates and powers all ground systems such video receiver, command & control and telemetry transceivers, transmitters and receivers, MFD, MCDU, visual displays and video goggles. Power input can be provided either by battery sources or 220V AC.



# UNMANNED SYSTEM APPLICATION EXAMPLES

## Civil Defence, Law Enforcement & Intelligence

Surveillance - Border & Coastal Patrol - Law Enforcement - Civil Disaster Response & Disaster Relief - Forest Fire Patrol - Fire Scene IR Mapping- Human Search and Rescue Coordination - Highway/Road Traffic Monitoring - Incident Response - Aerial Surveying - Homeland Security - Public Order & SWAT Support - Communication Relay - NBC Detection - Light Cargo Drops - Crime Scene Investigation & Mapping - Snow Pack & Avalanche Monitoring

## Scientific, Commercial & Civilian

Civil Flying Schools - Weather and Atmospheric Monitoring - Environmental & Agricultural Monitoring - News & Media Coverage - Railway, Pipeline and Power Line Inspection & Patrol - High Value/Risk Surveillance - Commercial Security - Aerial Surveying - Dam Inspection - Volcanic Exploration - GIS and Archeology Mapping - Buildingsite Status Monitoring - Structural Inspection - Wildlife & Environment Observation - Movie and Advertising Filming/Shooting - Aerial Effects for Flying Sequences - Arctic Exploration - Forestation Studies - Agricultural Crop Surveys - Migration Studies - Aerial Fish Spotting - Ice Pack Monitoring - Video Repeater & Communication Relay - Aerial Photography - Scientific Instrumentation - Advanced Unmanned Airframe Testing System (AUATS) in combination with FlightVision3D

## Military & National Defence

Military Aeronautic Flying Schools - MILES (Multiple Integrated Laser Engagement System) and Paintball based Realistic Military Tactical Trainings - Intelligence, Surveillance, and Reconnaissance (ISR) - Target Acquisition & Verification - Real Time Battle Field Command Observation - Combat Unmanned Aircraft - Infantry Advancement Support & Escort - Convoy Escort - Beyond Horizon Surveillance - Battle Damage Assessment (BDA) - Chemical, Biological and Nuclear Remote Sensing - Rapid Smoke Camouflage Disbursement - Mine and Bomb Detection - Advanced Remote Recognition for Terrain and Sea Special Corps - Remote Controlled Mobile Gun - Video Repeater & Communication Relay - Harbor Patrol - Nuclear Plant Patrol



**! CLASSIFIED !**  
Available on request



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