New GPS Technologies

FOR HELICOPTER SAFETY
LP & LPV Approaches

- Localizer performance with vertical guidance (LP/LPV) are the highest precision GPS (SBAS enabled) aviation instrument approach procedures currently available. Provides CAT I equivalent approach. LPV approach can provide vertical guidance to minima as low as 200 feet AGL.

- Made possible by SBAS

CAT I approach capability provided
By CMC’s CMA-5024 & CMA-6024
PinS: Point in Space Approach

- An approach procedure originally designed for helicopters that includes both an instrument and a visual segment
- PinS approaches can have LNAV or LPV minima
- Approach will be up until a point in space (MAP), after which, the pilot should have visual reference to the landing site (Helipad) or initiate missed approach
- Main advantage is the flexibility to position the MAP freely. Especially in obstacle/congested areas e.g. NYC

Supported by CMC’s CMA-5024 & CMA-6024
ADS-B Out

Automatic dependent surveillance – broadcast (ADS–B) is a cooperative surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

An SBAS Certified GPS is recommended by the authorities and provides best integrity and availability

- Flight ID
- Position + Certainty
- Altitude
- Vertical Tendency
- Distance
- Heading
- GS/IAS

Supported by CMC’s CMA-5024 & CMA-6024
LP & LPV Approaches

- GBAS: Ground Based Augmentation System augments the existing GPS utilized in the airspace by providing corrections to aircraft in the vicinity of an airport in order to improve the accuracy of, and provide integrity for, these aircrafts' GPS navigational position.
- The goal of GBAS implementation is to provide GLS approaches, an alternative to the Instrument Landing System (ILS) supporting the full range of approach and landing operations CAT I/II/III
- LAAS: Local Area Augmentation System, US implementation of GBAS

Available on CMC’s CMA-6024
GVS: GPS Velocity Sensor

- CMC’s GPS Emulates Doppler Velocity Sensor (DVS) used in Hover Hold
- GVS takes advantage of existing AP interface and controls: Plug&Play. No difference in operation
- Extremely precise (drift 2cm/24hr) vs. Doppler (1m/mins)
- No new equipment = less weight

Available on CMC’s CMA-5024 & CMA-6024
GVS: GPS Velocity Sensor

- Zero drift hover hold: Predictable ➔ reduce workload increase effectiveness
- Not affected by environment, terrain, current or rotor downwash
- Other capabilities not affected: ADS-B, LPV, RNP ...
- Flight tested and certified on Bell412EP. Technical paper on success story presented at AHS in 2011

Made possible by CMC’s CMA-5024 & CMA-6024
LPV Approaches

FOR OFFSHORE HELICOPTER OPERATIONS
LPV for Helicopter Offshore Operations

Localizer Performance with Vertical Guidance

A satellite-derived, synthesized Instrument Landing System using GPS-SBAS to provide higher levels of precision and safety during helicopter approach and landing for offshore operations.

NOTE: Offshore helicopter operations usually refers to water-installed oil/gas fixed base platform personnel and cargo support operations using large transport helicopters.
LPV for Helicopter Offshore Operations

• Benefits to helicopter offshore operator
  – Provides a safe oil platform helideck approach solution where visibility may be reduced by weather or darkness (traditional nav aids are not installed)
  – May permit lower approach minima than today
  – Allows for higher degree of flight/mission completion
  – Supports an integrated solution
  – Reduces flight crew workload
  – ILS look-alike support easy aircraft integration and pilot training

• Application where it can be used
  – Any helicopter where lateral & vertical deviation information can be displayed to the flight crew
  – Any fixed-base landing pad with known GPS position information where new Approach Procedures can be written
LPV in Use Today

LPV can only be enabled if the positioning source is an SBAS/GPS receiver. An SBAS receiver also meets/exceeds the ADS-B requirement for a high integrity position source.

LPV is similar to ILS LOC/GS, enabling accurate descent to 200-250 feet above the helideck. A “Delta-4” SBAS receiver outputs look-alike LOC and GS guidance.

LPV approaches are operationally equivalent to ILS. However, LPV does not require installation of navigation infrastructure on helidecks - is contained entirely within the helicopter avionics.

There are over 3000 LPV approaches in use today by GA and EMS helicopter operators in the US and the FAA publishes 300 new LPV approaches/year, see next slide for WAAS procedures.
## WAAS-Capable Approaches  
(by Procedure Type), March 2016

<table>
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<th>Procedures at NON Part 139 airports</th>
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LPV Operations Approved in the US

As of January 7, 2016
3613 LPVs serving 1756 airports
2466 LPVs to non-ILS runways
1687 LPVs to non-ILS airports
1147 LPVs to ILS runways
Current Offshore Approach Issues

• Typically flown using standard raw data – poor precision when visual cues are degraded or absent
• Tend to result in high workload for the flight crew especially in poor visibility
• Standard weather radar is used to identify platform centre of mass and avoid obstacles – NOT ideal
• Single radar altimeter used for height
• Not operator friendly
• No precise lateral deviation/guidance
• Wind not accounted for
• Significant training burden
LPV Helicopter Approach Benefits

- Provides standard LOC/GS guidance visual cues
- Integrated with helicopter AFCS for coupled approach – possible lower landing minima
- LPV is a straight-in approach to any oil platform
- Establishes a safe missed approach procedure
- Crew uses weather radar and radar altimeter for verification
- “Bolt-On” avionics retrofit to existing helicopters, no oil platform equipment required
Standalone LPV with CMC GLSSU

- GLSSU sensor provides both navigation (Beta-3) and standalone LPV capability (Delta-4). Beta-3 = best SBAS navigation performance Delta-4 = SBAS LPV LOC and GS guidance is provided.

- ARINC 743B compliant
  J1 navigation connector (1Hz)
  J3 approach connector (20Hz)
  Complete Solution update (10Hz)
  J2 RF connector (antenna C190)

- LP/LPV installs “on top of” FMS, LPV Database hosted in GLSSU, Control Panel selects the LPV and manages the GLSSU

- Growth to GBAS/LAAS GLS with future upgrade

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GPS Landing System Sensor Unit (GLSSU)

CMA-5025 GLSSU Control Panel

CMA-5024 GLSSU Landing Guidance Unit
LPV Landing Guidance Architecture

- Radio-Nav Control Heads
- DME
- VOR
- Flight Mode Select
- GLS Source Select
- CMA Control Panel
- Flight Guidance Displays
- Flight Mode GLS Annunciator
- Nav System
- CMA-5024 GLSSU & High Integrity Switch
Fully Integrated IFR & Landing Guidance

- FMS flies published IFR routes and standard LNAV procedures to LPV FAF
- Transition to LPV at FAF, GLSSU provides LPV LOC/GS
- Continuous guidance en-route, terminal area, near-precision approach
- FMS can host the LPV database
- Fully integrated enroute and approach LNAV, LNAV/VNAV, LP, LPV with future upgrade to GBAS (GLS)
LPV with FMS, GPS-WAAS & SBAS

• Precision Approach to 200 feet (FAA 200 feet « near Cat-1 »)

• GLSSU: a dual purpose GPS Sensor
  – Provides RNP Navigation Capability
  – Provides Approach Capability, including Precision Approach Navigator, Localizer, Glide Slope and DME outputs
  – “BOLT-ON” solution for easy retrofit or new aircraft integration
  – Low Altitude IFR for helicopters using SBAS

• Helicopter LPV Operations
  – Pilot selects approach source (either ILS or LPV) per approach plate
  – If LPV approach is selected, GLSSU switches out ILS Receiver LOC and GS and replaces with GLSSU calculated LOC and GS (ILS look-alike)
  – If ILS is selected, ILS “passes through” GLSSU “as-is” (like through relay)
LPV Offshore Approach Procedure

- **IAF**
- **FAF**
- **MAP**

**Plan View**
- Initial Approach Segment: 2 NM
- Final Approach Segment: 0.75 NM
- Missed Approach Segment: 0.5 - 0.6 NM

**Profile View**
- Min MDA: 200 ft (300 ft at night)
- Deck Height: 50 ft

**Oil Rig**
- HeliDeck

**HeliDeck**
- Offset: 0.25 NM
- Heli Deck: 4 - 6°
Summary

• Typical helicopter offshore operations need a better, safer and far more precise instrument approach procedure to offshore platforms

• WAAS in the US and EGNOS in Europe offers a very unique solution with many other benefits for offshore operators

• LPV holds the promise of significantly enhancing safety of operations through improved positional and approach path accuracy

• LPV operations will only require minimal cost equipment installed on the helicopter and virtually none on the oil platform helideck