



EFVS RADAR IN 31.8-33.4 GHz BAND FSMP

AUGUST 2022

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CURRENT SITUATION

5.547 A Footnote : Administrations should take practical measures to minimize the potential interference between stations in the fixed service and airborne stations in the radionavigation service in the 31.8-33.4 GHz band, taking into account the operational needs of the airborne radar systems. (WRC-2000)

29.9-34.2 GHz		
Allocation to services		
Region 1	Region 2	Region 3
31.8-32	FIXED 5.547A RADIONAVIGATION SPACE RESEARCH (deep space) (space-to-Earth) 5.547 5.547B 5.548	
32-32.3	FIXED 5.547A RADIONAVIGATION SPACE RESEARCH (deep space) (space-to-Earth) 5.547 5.547C 5.548	
32.3-33	FIXED 5.547A INTER-SATELLITE RADIONAVIGATION 5.547 5.547D 5.548	
33-33.4	FIXED 5.547A RADIONAVIGATION 5.547 5.547E	

5.547 B-C-D-E Footnotes : Alternative allocation: in the United States, the band 31.8-33.4 GHz is allocated to the radionavigation and xxxxxxxx services on a primary basis.

REMINDER

- **September 2016** : FSMP WG03, FRANCE proposed to upgrade the ***PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R M.1466-0*** to a ***DRAFT REVISION (FSMP-WG03-WP07_1466 Agenda item 6)***
- **January 2017** : Recommendation ITU-R M.1466-1 *Characteristics of and protection criteria for radars operating in the radionavigation service in the frequency band 31.8-33.4 GHz* recognizes the radar characteristics developed by Dassault Aviation for Enhanced Flight Vision System (EFVS).
- **July 2018** : The ECC approves the new ECC Decision (18)06 *Harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz*, before WRC19
Due to IMT allocation in this band, Fixed Service has to move to other frequency bands, including 32GHz band.
- **May 2022** : ICAO Flight Ops Panel WG/9, *Update of latest development on EFVS* working paper
- **May 2022** : European Frequency Management Group - CM/2022, *The Meeting encouraged States to support ICAO in ITU WP5C sharing studies between the FIX service and EFVS using the 31.8-33.4GHz frequency band.*

→ Ongoing discussions within ITU WG-5C for recommendation ITU-R F.1520 update.

RADAR BASED EVS/EFVS - WORLDWIDE INTEREST - STUDIES -

- EFVS is a key enabler mentioned in following roadmap:
 - US NAS (National Airspace System) plan 2016
 - US NEXT GEN program – 2016, 2019
 - EU Aviation strategy : ATM Master plan 2021
 - China CAAC roadmap -2012-
- Radar based EFVS studies have been performed through:
 - Next Gen
 - CORAC (France) – IKKY & TOUCANS -
 - SESAR (Europe) : H2020 PJ03a-04, H2020 W2PJ02 17.4a
 - *“Use of active sensor with improved performance to overcome the observed limitation of EVS legacy sensors”*
 - PEGASE (Europe - <https://www.cdti.es/recursos/doc/eventosCDTI/Aerodays2011/3B4.pdf>): 2009 – radar sensor in 35 & 95GHz
- Radar based EFVS is promoted by:
 - NASA : from 90th to 2021 (pioneer and lead for EFVS including radar)
 - SC123/ WG79 EFVS/ SVS standardization group
 - Aircraft manufacturers : Gulfstream, Dassault Aviation, AIRBUS,...
 - Avionic Suppliers : THALES, HONEYWELL -RDR-84K-, SNC -2018 petition for introducing frequency allocation in rulemaking for EFVS-



DASSAULT AVIATION 32 GHZ SENSOR CONCEPT

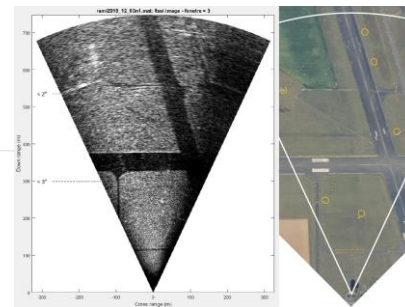
- **FR PATENT N° FR 3094095** <https://data.inpi.fr/brevets/FR3094095>
- **PATENT APPLICATIONS :**
 - US N° 20200302807 - 16/821,361 [uspto link](#)
 - CANADA N° 3,076,037
 - EU N° 20163593.5

DASSAULT AVIATION 32 GHZ SENSOR CONCEPT

- **Frequency Modulation Continuous Wave (FMCW)**
- **Multiple Input / Multiple Output principle. Array of N antennas. Number of antennas depends on the Radar configuration which is adapted in order to fit to each aircraft type.**
- **Visual recognition of the runway and its environment by the pilot on a Radar image shown on a Head Up Display**

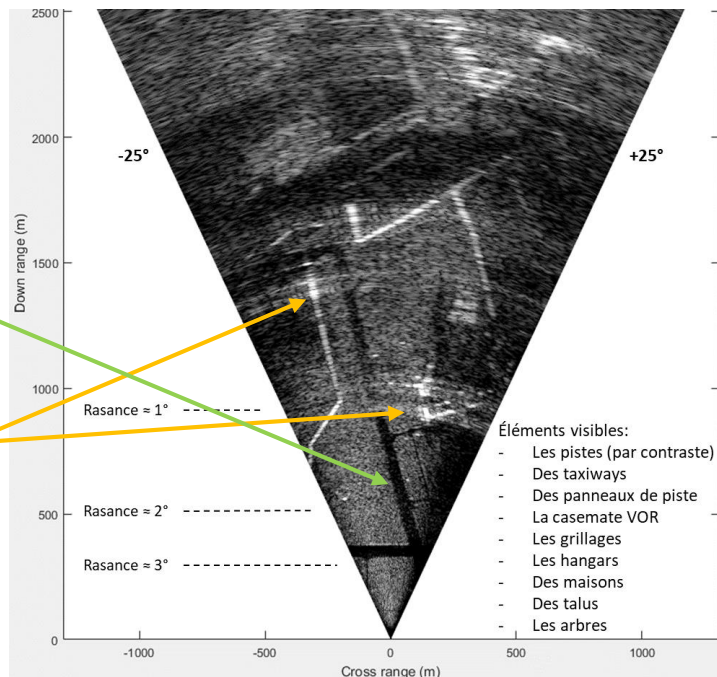
CORAC STUDIES – 2019 MAIN RESULTS

SENSOR PROOF OF CONCEPT AND GROUND MEASUREMENTS IN LFPT

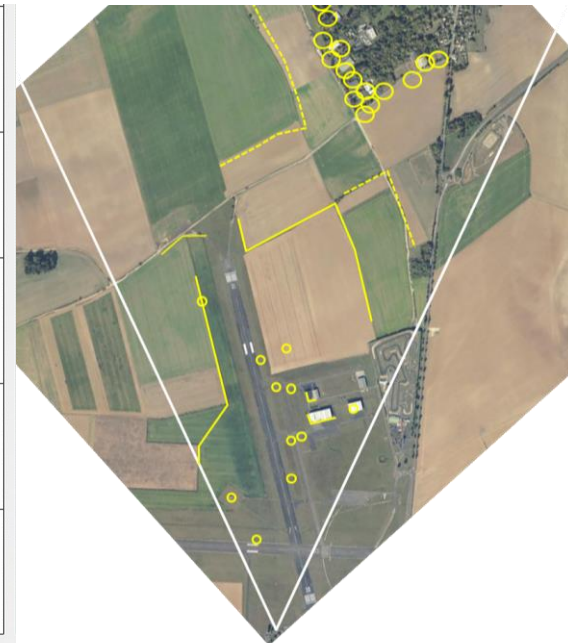


Ground features of main interest (runway, grass) are at very low level...

...among very high level reflectors (buildings, antennas, airplanes, fences, etc.)

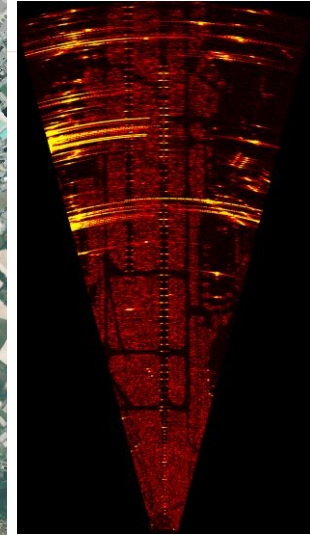


- Éléments visibles:
- Les pistes (par contraste)
 - Des taxiways
 - Des panneaux de piste
 - La casemate VOR
 - Les grillages
 - Les hangars
 - Des maisons
 - Des talus
 - Les arbres

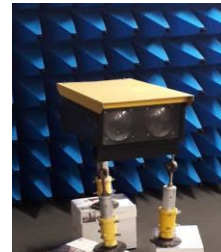


SESAAR STUDIES – 2021 MAIN RESULTS

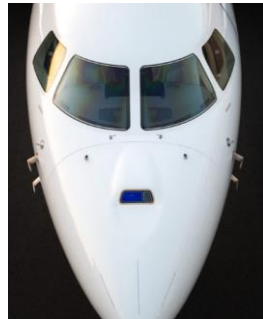
- Multi-Spectral (EO/IR + EM) sensor simulation, matched to real environment measurement data and Radar Cross Section measurement in anechoic chamber of “airport objects”.
 - Multi-Spectral sensor data fusion and detection algorithms
 - System integration
 - Simulation based evaluation by pilots
- System concept definition
- Radar image quality requirements based on pilot experience



This solution was developed within the context of the SESAAR project "Airport airspace and runway throughput (IP102-W2)", which received funding from the SESAAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 878477



- **Ongoing work with AIRBUS :**
- Development of multi-platform compatible sensor architecture
- Sensor simulation on different scenarios for the different sensor configurations



EFVS RADAR BANDWIDTH

- **Vision based manual landing needs a visual recognition of the runway and its environment by the pilot on a Radar image shown on a Head Up Display**
 - High Range Resolution specified (metric class) in order to discern different very close features
 - Large band needed
- **Reflectors with very high dynamic in terms of Radar Cross Section (runway, grass, signs, runway and approach lamps, PAPI, buildings, fences, etc.)**
 - Very low secondary lobes weighting window needed (Blackman, Kaiser, ...) in order to detect the different features
 - Extra band needed for compensation of the Range Resolution degradation due to weighting window

For the pilot to recognize the environment in the vicinity of the runway, the need in terms of image quality and the characteristics of the features on the ground drive the need for bandwidth.

Combined with the need related to MIMO technology (emission of N independent signals) the overall need for bandwidth is at least 320 MHz.

WAVE FORM EFVS RADAR

