# LMS AND H-SATCOM CHANNELS CHARACTERIZATION AT X AND KU BANDS


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## Motivation of the work:

- Communications between individuals and between portable devices are of great importance today.
- It is necessary to consider new frequency bands wherein large amounts of required data can be transmitted.
- In this work I study the characterization and modelling of the radio channel satellite communications in X and Ku bands.
- Two radio channels are investigated: Helicopter Satellite Communications (H-SATCOM) and Land Mobile Satellite (LMS).

## Thesis Objectives:

**The main objective of this research project is to study, characterize and modelling H-SATCOM and LMS radio channels in the X and Ku bands [1].**

The objectives are:

- Design, fabricate and calibrate an ad-hoc measurement system using a sweep time delay cross-correlation (STDCC) sounder.
- Measurement of H-SATCOM and LMS radio channels.
- Wideband and narrowband study and modelling of the proposed radio channels.
- Analysis of spatial and polarization diversity technics to mitigate the radio channel impairments.
- Analysis of vegetation scattering under an anechoic chamber conditions.

## Research Plan:

| | Task | Duration | Month 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Literature review | 4 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Measurement system designs using STDCC techniq. | 2 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Definition of measurement scenarios | 2 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Carried out the H-SATCOM measurements | 2 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | H-SATCOM radio channel analysis and modelling | 6 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Carried out the LMS measurements | 1 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | LMS radio channel analysis and modelling | 5 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Carried out vegetation measurements | 2 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Vegetation scattering analysis and modelling | 6 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Documentation | 3 M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

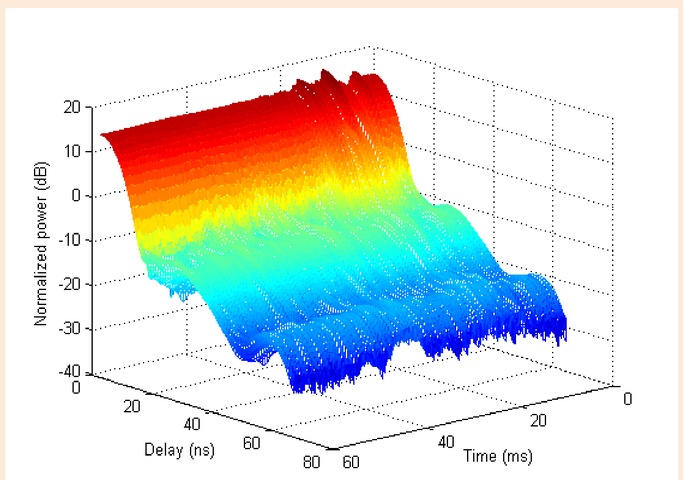
## Next Year Planning:

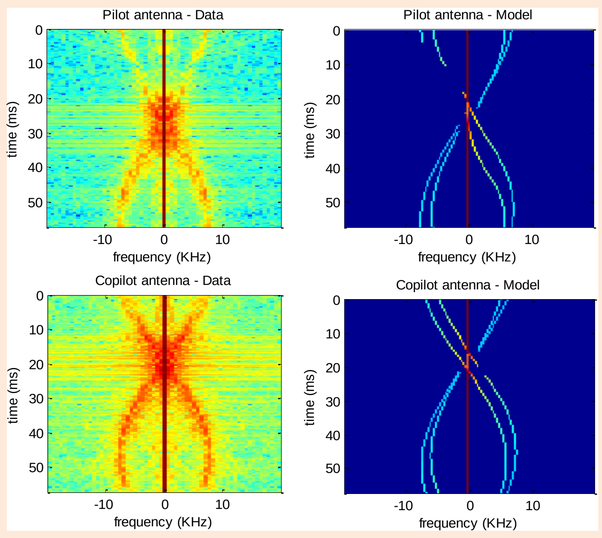
- LMS narrowband analysis and modelling.
- LMS channel diversity improvements study.
- Modelling the vegetation scattering measurements.
- H-SATCOM micro Doppler analysis.

## Results & Discussions:

**H-SATCOM [2]-[5]:**

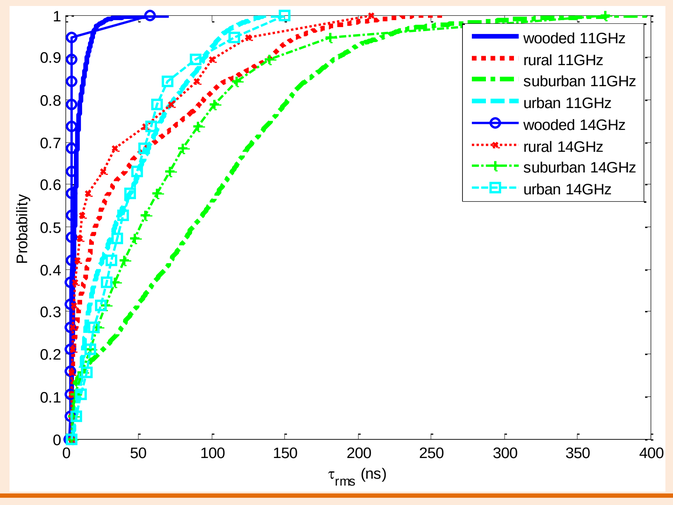
- Ku band analysis.
- Spatial and polarization diversity.
- Not selective in frequency for 32 or 72 MHz transponders.
- Time-varying complex signal envelope with a Deep signal fading and Oscillatory behaviour.
- 3D ray tracing model.


**LMS [6]:**

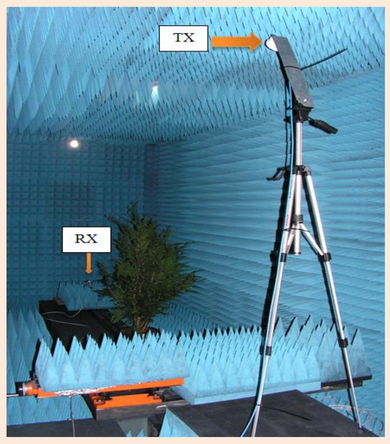
- Larger values have been obtained for the urban and suburban environments.
- Small or high $\tau_{rms}$ values at different positions in the rural environment.
- $\tau_{rms}$ values are smaller at wooded areas.

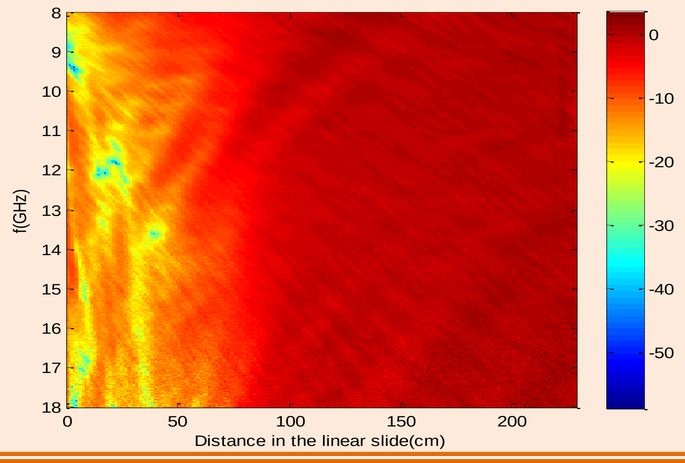



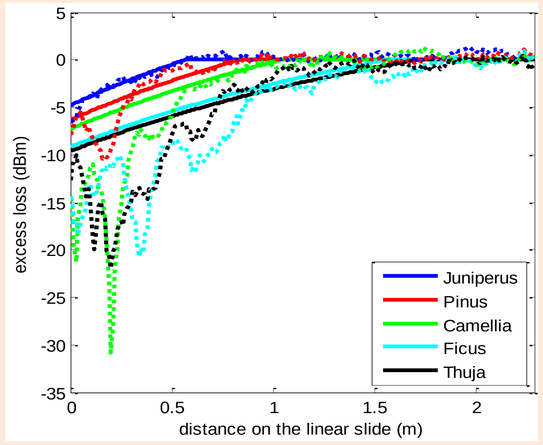

| *Environment* | *STATE 1* | *STATE 2* | *STATE 3* | *Total* |
|---|---|---|---|---|
| | *PROBABILITY AT 11.2 GHz / 14.155 GHz* | | | |
| *Wooded* | *0.18 / 0.08* | *0.33 / 0.25* | *0.48 / 0.67* | *1 / 1* |
| *Rural* | *0.23 / 0.09* | *0.25 / 0.21* | *0.52 / 0.69* | *1 / 1* |
| *Suburban* | *0.10 / 0.12* | *0.31 / 0.31* | *0.59 / 0.58* | *1 / 1* |
| *Urban* | *0.05 / 0.05* | *0.23 / 0.19* | *0.72 / 0.76* | *1 / 1* |
| | *COHERENCE BANDWIDTH (MHz) EXCEEDED 95 % OF THE TIME FOR C=0.7 AT 11.2 GHz / 14.155 GHz* | | | |
| *Wooded* | *58 / 60* | *34 / 42* | *14 /18* | *19 / 37* |
| *Rural* | *57 / 13* | *31 / 15* | *13 / 10* | *20 / 13* |
| *Suburban* | *44 / 55* | *6 / 32* | *2 / 2* | *4 / 2* |
| *Urban* | *38 /59* | *8 / 21* | *4 / 4* | *8 / 5* |

**Vegetation [7]:**

- Power fading models require to be improved to consider short propagation distances travelled through the vegetation medium.

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