Microwave Digital Camera for the real-time Measurement and Analysis of the Radar Cross Section of Time-Varying Targets

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Time varying targets

- Reflectivity variations are induced by geometrical or radio-electrical distortions
- Examples: helicopter blades, jet engine, electronic devices,…

- Modulation of the transmitted signal
- Fast variations of the Radar Cross Section

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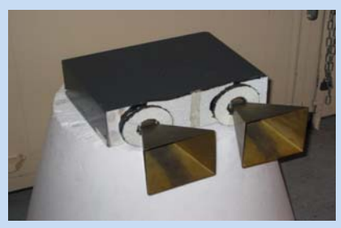
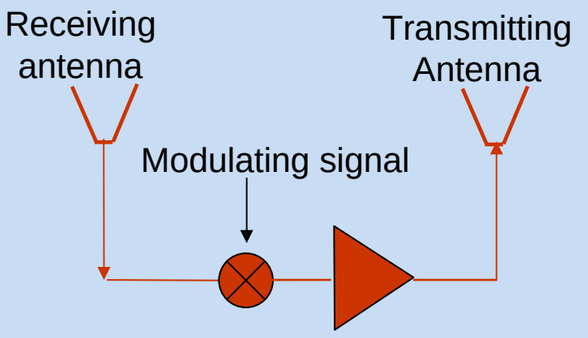
- Wideband Measurement for RCS imaging
- Short measurement time to consider the time-varying phenomenon as stationary

RCS measurement of an active transponder



Active transponder VEGA

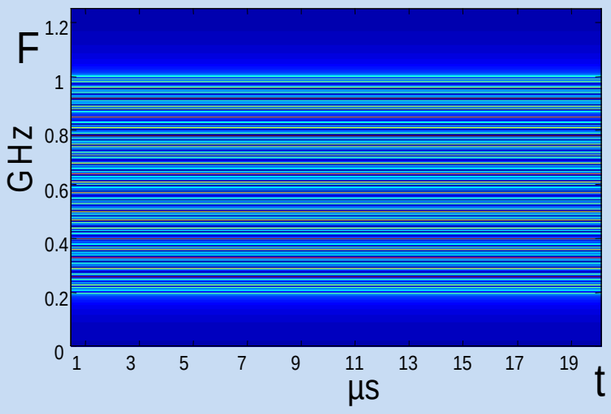


- **Indoor measurement (anechoic chamber)**

Transmitted Waveform: multicarrier signal (OFDM)

- A set of orthogonal frequencies are transmitted simultaneously :

$$s(t) = \frac{A}{N}\sum_{n=1}^{N} e^{2j\pi\frac{nt}{T}+\phi_n}$$

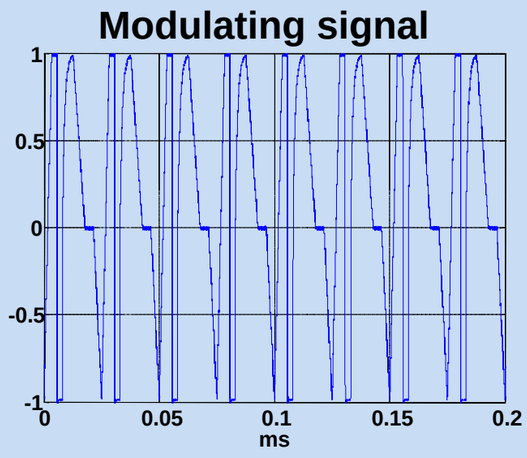


- Phase Coding to minimize the signal's Peak to Mean Power Ratio (PMEPR)

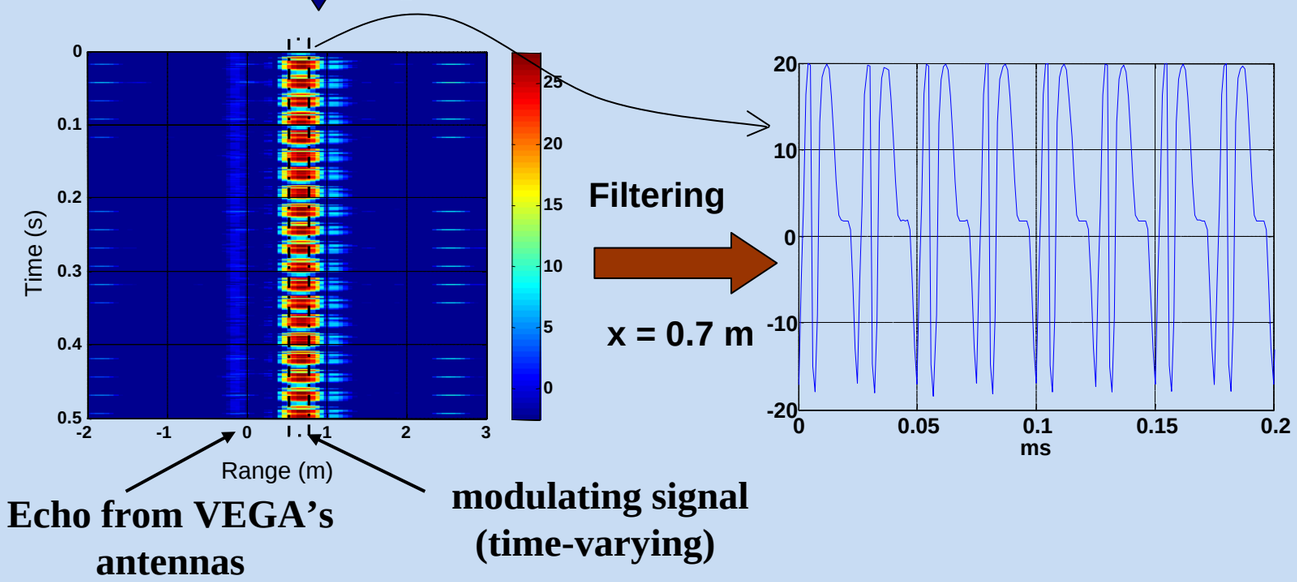
Newman's Code : $\phi_n = \frac{\pi(n-1)^2}{N}$ → Low PMEPR (≤ 2dB)

- Extraction of the modulating signal
- Process:

1. Measurement of the scattering coefficients $\rho(F,t)$
2. FFT on the frequencies

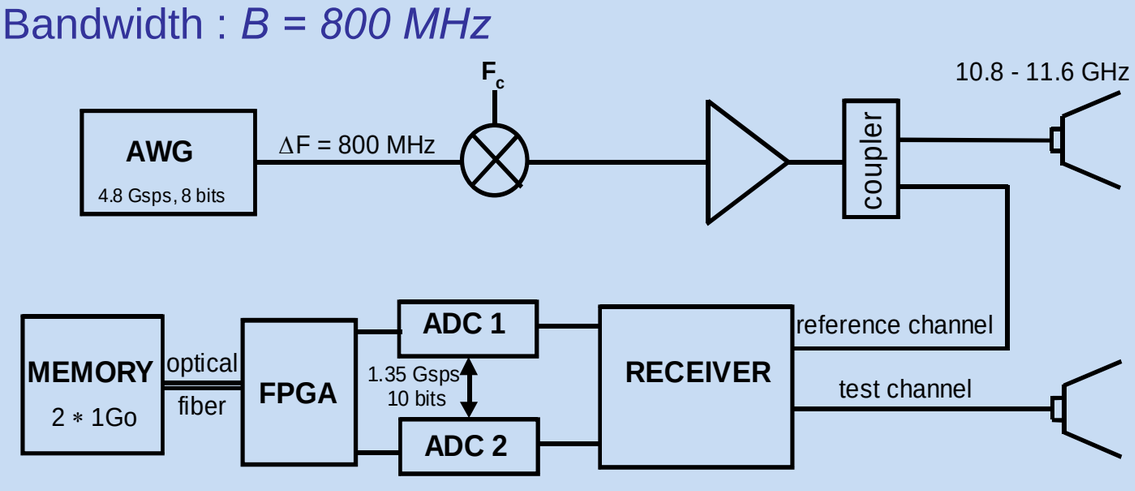


Time-range response



Experimental System

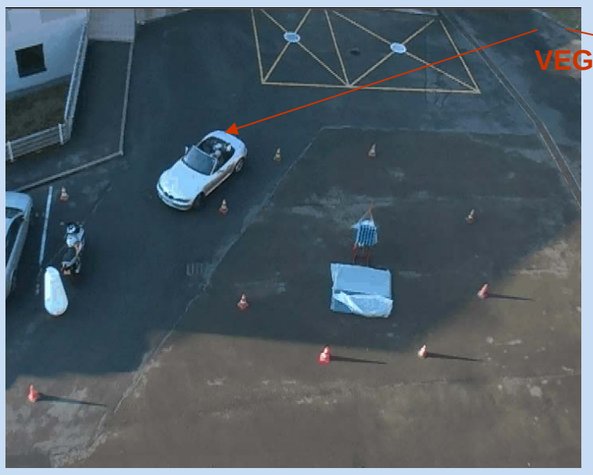
- Bandwidth : *B = 800 MHz*



- Reference and test channel are interleaved (orthogonal frequencies)

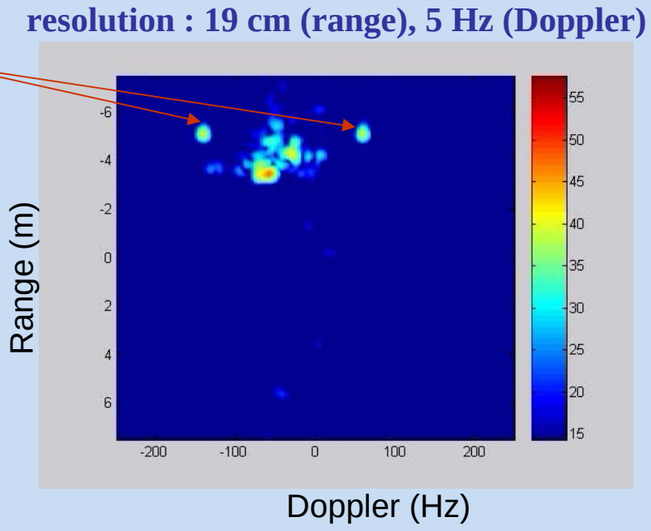
- **Outdoor measurement on moving targets (camera mode)**

Modulating signal : $f_m = 100\ Hz$



Optical image

Range-Doppler response
resolution : 19 cm (range), 5 Hz (Doppler)



Radar image

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