IEEE IGARSS 2020
2020 IEEE International Geoscience and Remote Sensing Symposium
July 19 – 24, 2020 • Waikoloa, Hawaii, USA

Characterization of the walking activity within the forest by using a Doppler analysis in the UHF-BAND

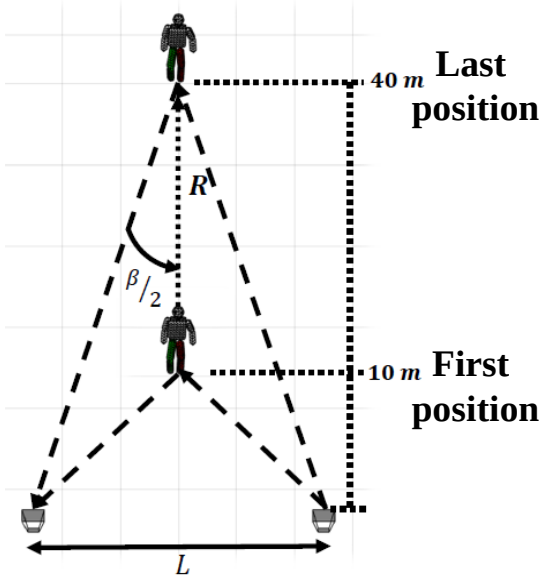
G. Manfredi[§], I. Hinostroza[§], M. Menelle[†], S. Saillant[†], J.-P. Ovarlez[*§], and L. Thirion-Lefevre[§]

[§]*SONDRA, CentraleSupélec, Université Paris-Saclay, 91190 Gif-sur-Yvette, France*
[†]*ONERA, Université Paris-Saclay (DEMR/EGDR), 91120 Palaiseau, France*
[*]*ONERA, Université Paris-Saclay (DEMR/MATS), 91120 Palaiseau, France*

giovanni.manfredi@centralesupelec.fr

Bistatic radar setup and signal processing

Bistatic radar working in continuous way (CW)



Measurement setup

Parameters	1 GHz	435 MHz
Antennas	Log-periodic	Yagi
Polarization (POL)	VV, HH	
Distance travelled (R)	30 m	
Distance antennas (L)	16 m	
Bistatic angle (β)	77°-22°	

Subject walking 30 m within the wood away from the antennas

Short-Time Fourier Transform (STFT)

$$S(t,f) = \left| \int_{-\infty}^{\infty} s(u) h^*(u-\tau) e^{-i2\pi f u} du \right|^2$$

s(u) = received signal in *I* and *Q* components;

h(·) = smoothing Hanning window;

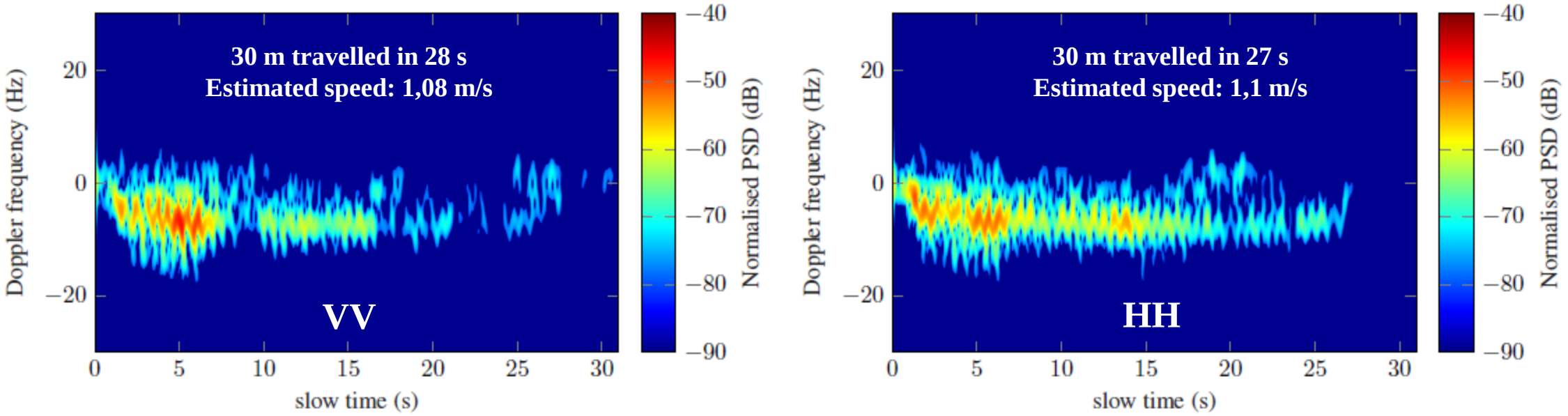
S(t, f) = spectrogram distribution;

Coherent Processing Interval (CPI) = 0,5 s;

Time stride = 10 ms;

Overlap = 80%.

Doppler frequency signature of a man walking into the wood analyzed at 1 GHz



Doppler speed [1]

$$v_D = \frac{\lambda F_D}{2\cos\left(\beta/2\right)}$$

F_D = Doppler frequency;

λ = wavelength;

Doppler characteristics of the walk [2]

Features	VV	HH
1) Torso Doppler	5,29 Hz	6,29 Hz
Doppler speed	**0,7 m/s**	**0,95 m/s**
2) Period	0,53 s	0,54 s
3) Total BW	23,95 Hz	24,88 Hz
4) Offset	11,98 Hz	12,44 Hz

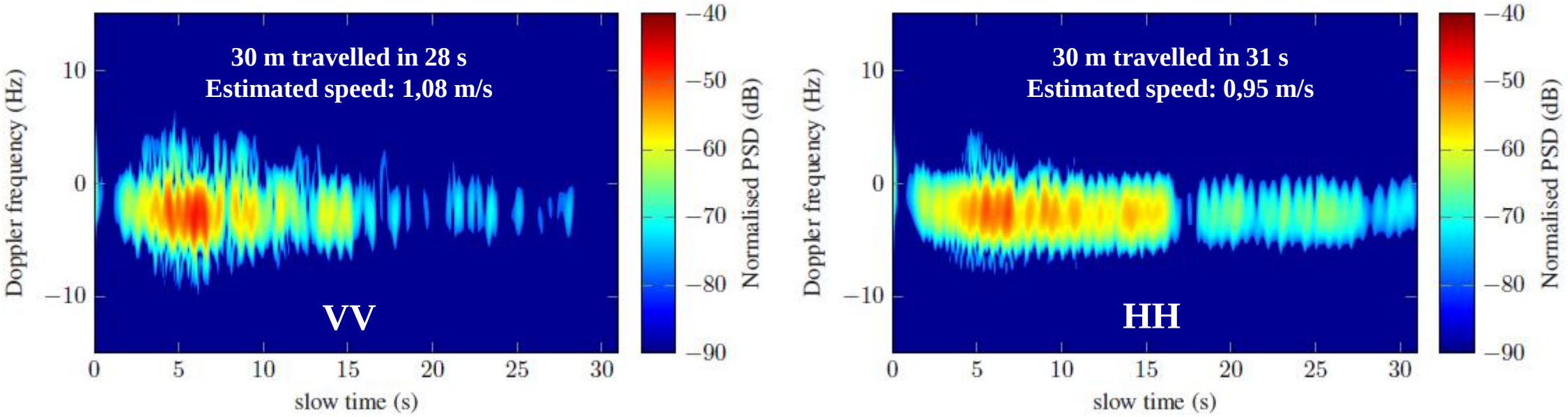
References

[1] N. J. Willis, Bistatic radar, vol. 2, SciTech Publishing, 2005.

[2] G. Manfredi, J.P. Ovarlez, and L. Thirion-Lefevre, "*Features extraction of the Doppler frequency signature of a Human walking at 1 GHz*", in IGARSS 2019-2019 IEEE International Geoscience and Remote Sensing Symposium. IEEE, 2019, pp. 2260–2263.

giovanni.manfredi@centralesupelec.fr

Doppler frequency signature of a man walking into the wood analyzed at 435 MHz



Doppler speed [1]

$$v_D = \frac{\lambda F_D}{2\cos\left(\beta/2\right)}$$

F_D = Doppler frequency;

λ = wavelength;

Doppler characteristics of the walk [2]

Features	VV	HH
1) Torso Doppler	2,45 Hz	2,61 Hz
Doppler speed	**0,85 m/s**	**0,9 m/s**
2) Period	0,69 s	0,66 s
3) Total BW	16,3 Hz	12,91 Hz
4) Offset	8,15 Hz	6,45 Hz

References

[1] N. J. Willis, Bistatic radar, vol. 2, SciTech Publishing, 2005.

[2] G. Manfredi, J.P. Ovarlez, and L. Thirion-Lefevre, "*Features extraction of the Doppler frequency signature of a Human walking at 1 GHz*", in IGARSS 2019-2019 IEEE International Geoscience and Remote Sensing Symposium. IEEE, 2019, pp. 2260–2263.

Giovanni Manfredi
Post-Doctoral researcher
SONDRA

Thank you so much for your attention.

Would anyone like to ask any questions?