

WHAT'S INSIDE THE BUILDING?

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BACKGROUND

- Why?
 - Forced break-in
 - Police operations
 - Rescue operations
 - Sniper detection
 - Civil and military use

- Close-up methods
 - Small TV, IR cameras
 - Wall-mounted radars
 - Microphones & Sonic sensors
 - Chemical
 - etc...

OK, but if close-up is not possible?

- Stand-off methods
 > 100 m
 - Remotely operated drones
 Feasible but not stealthy
 - Long wavelength airborne radar

SOME OBSTACLES FOR RADAR... AND METHODS...

<u>Obstacles</u>

- Line-of-sight
- Wall penetration
- Large wall returns
- Sensing humans
- Many internal objects
- Many objects close together



<u>Methods</u>

- Free choice with airborne system
- Long radar wavelengths
- Choose good viewing angles
- Meter-scale radar wavelengths
- High spatial resolution with radar / SAR
- Change analysis

WALL PENETRATION AND SENSING HUMANS



as dielectric parameters are approx. similar over frequency 1 *m* radar wavelength => Human RCS ~ 1 sq. m

LARGE WALL RETURNS



MITIGATING LARGE WALL RETURNS



EXAMPLE LARGE WALL RETURN



Large specular returns from walls obscure details inside the building



LONG-WAVELENGTH RADAR SYSTEM

in 1991, CARABAS II in 1997) Miniaturized electronics and antennas		
Dual bands and dual polar	rizations	
Successfully proven on Section	ns and UAVS	
Frequency low band	20-90 MH 7	SEAMN M
Resolution low band	2.8 x 2.8 sam	He man
HH & VV Polarization		
Frequency high band	140-360 MH z	
	07 x 07 sam	
Resolution high band		

BUILDING PENETRATION: TEST SITE



Radar look angle towards this building corner



REFERENCE TARGETS





1 m reflector

5 m reflector

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SAR IMAGE WITHOUT REFLECTOR



SAR IMAGE WITH REFLECTOR



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SAR IMAGE WITHOUT REFLECTOR



SAR IMAGE WITH REFLECTOR



SAR IMAGE – METALLIC STRUCTURES IN BUILDING



SAR image #1



Many metallic structures in the building – generates large returns

SAR IMAGE – METALLIC STRUCTURES IN BUILDING



SAR image #2



Many metallic structures in the building – generates large **and stable** returns

=> <u>Stable returns can be suppressed</u> <u>using two images</u>

COLOR IMAGE USING AN OVERLAY OF TWO SAR IMAGES

Green color channel = SAR image with no reflector in building Red color channel = SAR image with reflector in building

No changes will turn up in a yellow tone

Reflector is clearly visible

Internal metallic structures => yellow tone



CONCLUSIONS

- Airborne Long-Wavelength Synthetic Aperture Radar (SAR) technique

 a good solution for looking inside buildings
- Large internal reflections (inside building) are stable over time
 - due to that small objects do not scatter the radar wave
- Many internal building reflections are stable over time
- Multi-image analysis provides a technique to detect changes inside a building





THANK YOU FOR LISTENING!

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