Investigation of the Bragg Scattering of UWB Signal from the Window Blind: (1) Theoretical Investigation

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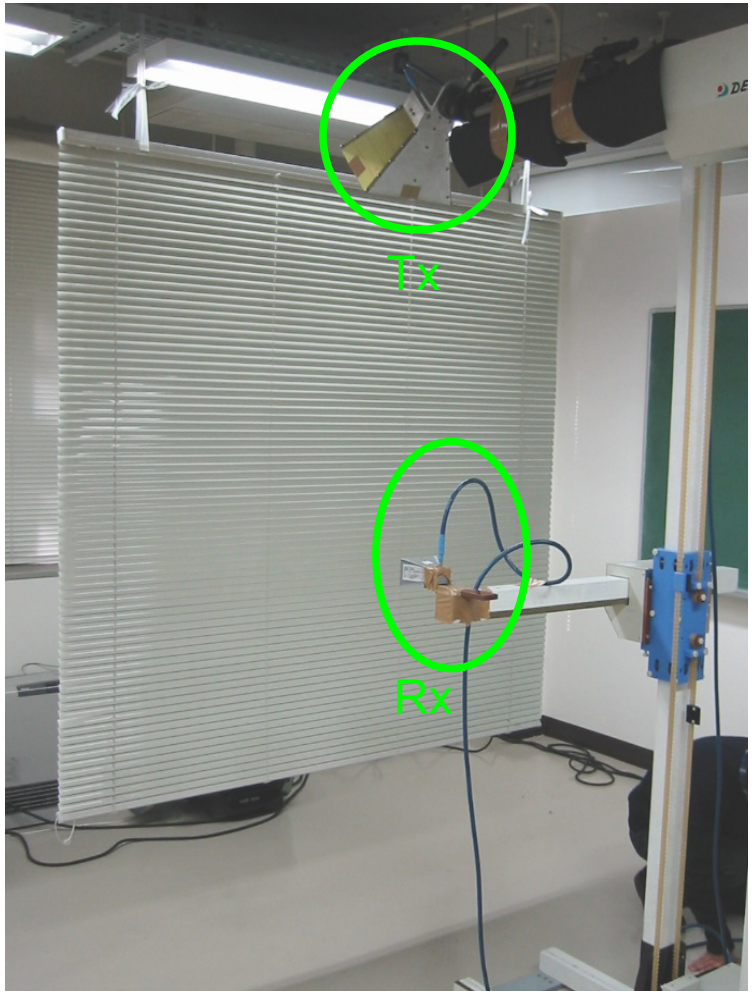
Presentation Outline

- Introduction
- Bragg Scattering
- Experiment
- Simulation
- Results and Discussion
- Conclusion

Introduction

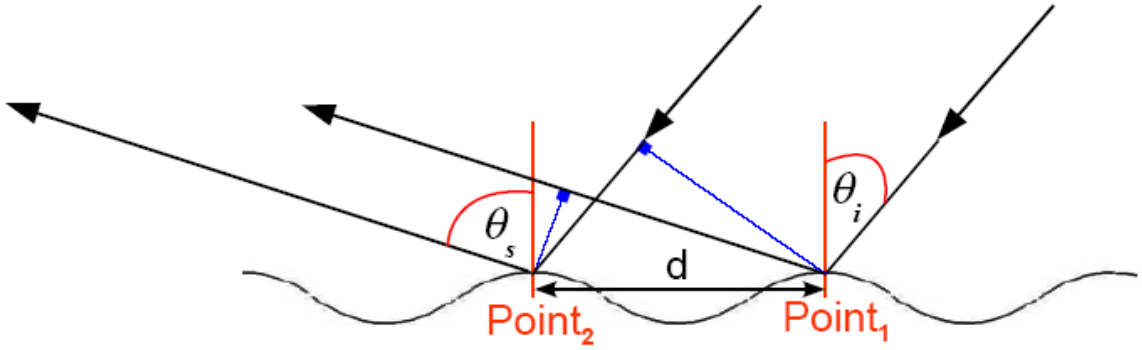


- Bragg scattering may not be negligibly small for the periodic structures.
- The frequency dispersive property may influence the transmission property of UWB systems.

Objective :

To investigate Bragg scattering from window blinds based on the experimental condition.

Bragg Scattering



Definition : diffraction relationship between the wavelength of an incoming ray and the period of the periodic structure

$$n\lambda = d\ \sin\theta_i - d\ \sin\theta_s$$

$$\theta_s = \arcsin\left(\sin\theta_i - n\lambda/d\right)$$

n = the order of reflection

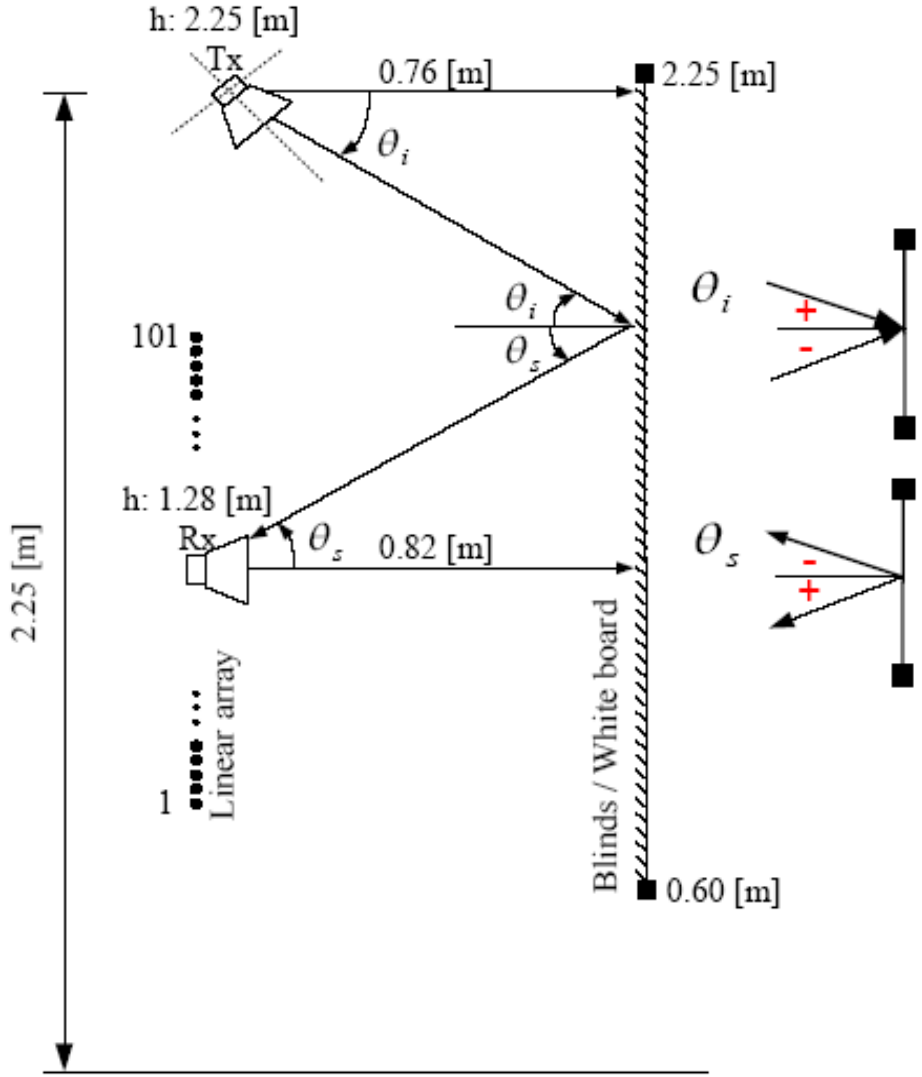
λ = wavelength of incident ray

d = interplanar spacing

θ_i = angle of incidence

θ_s = angle of reflection

Experiment



To determine the complex channel transfer function ***H(f)***

where

- Frequency : 3.1 to 10.6 GHz
- Tx antenna : fixed(on a pole)
- Rx antenna : a virtual linear array antenna whose element spacing is 1 cm.

Simulation (1)

Incident angle ($-90° \le \theta_i \le 90°$) and Bragg angle ($-90° \le \theta_s \le 90°$)

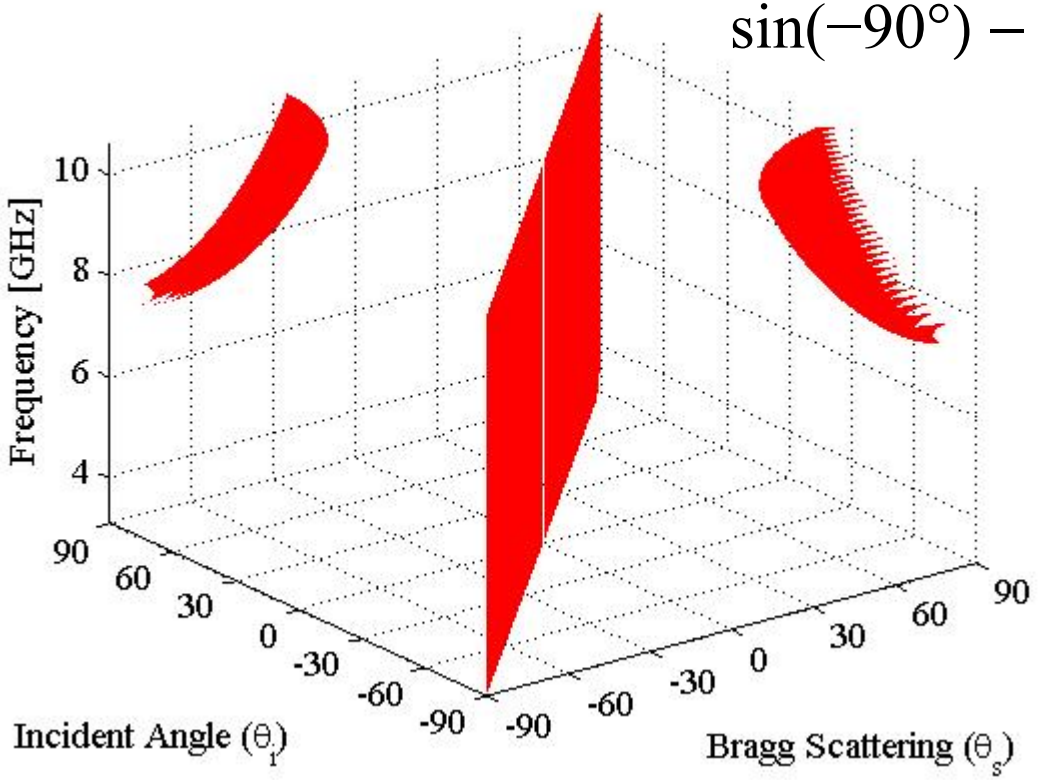
$$\sin(-90°) - \sin(90°) \le \frac{n\lambda}{d} \le \sin(90°) - \sin(-90°)$$

$$-2 \le \frac{n\,c}{d\,f} \le 2$$

$$\frac{-2\,d\,f}{c} \le n \le \frac{2\,d\,f}{c}$$

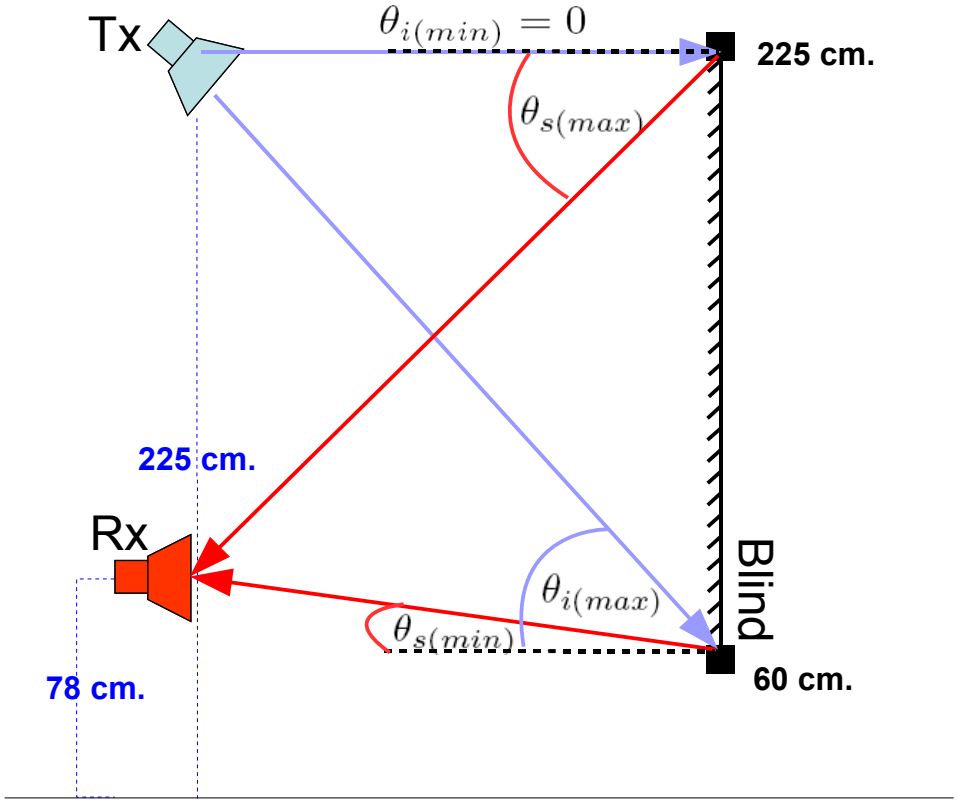
where d = 2 cm. and frequency is in UWB range

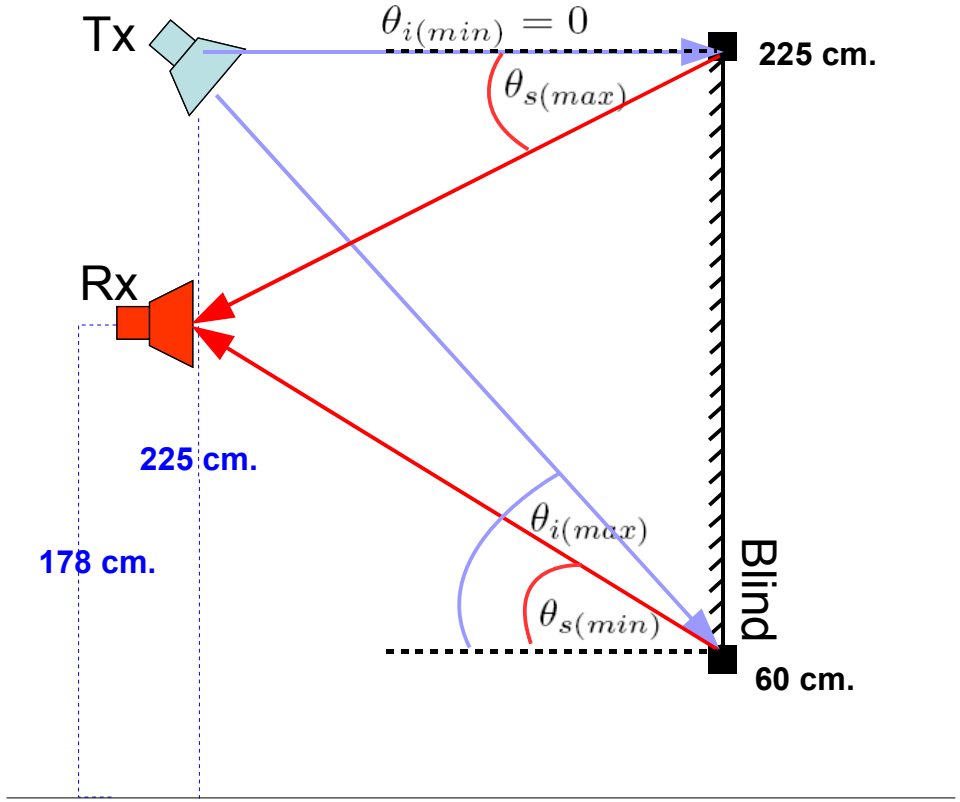
$$\therefore\ n = -1, 0, 1$$



Varying the possible order of reflection (n)

Simulation (2)

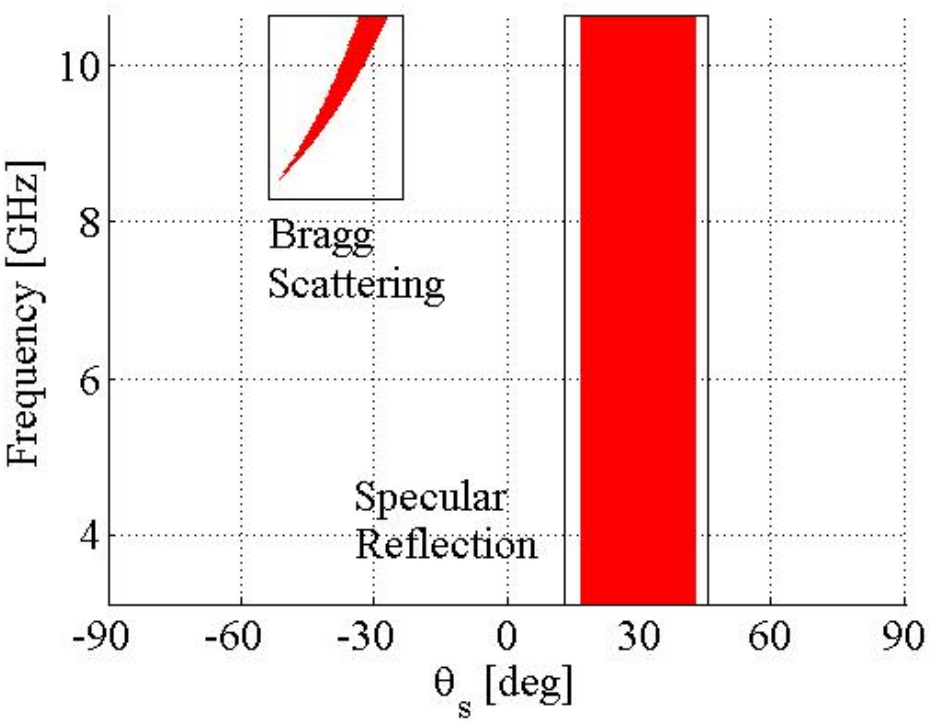




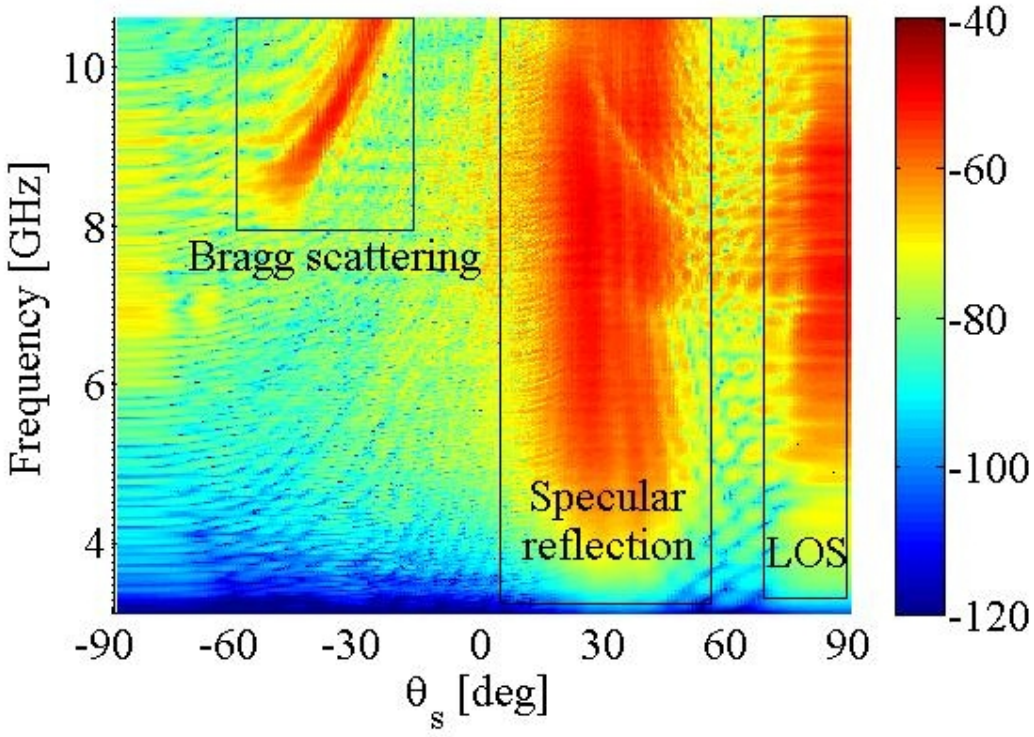
- The range of θ_i and θ_s bounded by the Tx and Rx position
- To satisfy the conditions, $0° \leq \theta_i \leq 65°$ and $-53° \leq \theta_s \leq 62°$

Results and Discussion

Simulation result



Experimental result



- The specular reflection and Bragg scattering regions are obviously observed in the theoretical model

Conclusion

- Compared the simulated Bragg scattering with the indoor UWB measurement on window blinds.
- Verified the theoretical Bragg scattering using the data processing of results.

Future Plan

- Simulate the same condition by utilizing the physical optics approximation method

Thank you
for your attention