

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title:** [VLC Channel Modeling Simulation for Metropolitan Scenario]

**Date Submitted:** [14 May, 2010]

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**Re:** []

**Abstract:** [Results of channel modeling simulation are presented. The impulse response of the LED lighting channel is simulated regarding the Automotive Head Lamp & Street Light Regulation in Metropolitan Scenario.]

**Purpose:** [Comments to IEEE 802.15.7 VLC TG]

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# VLC Channel Modeling Simulation for Metropolitan Scenario

2010. 05. 14

LED-IT Fusion Technology Research Center (LIFTRC),  
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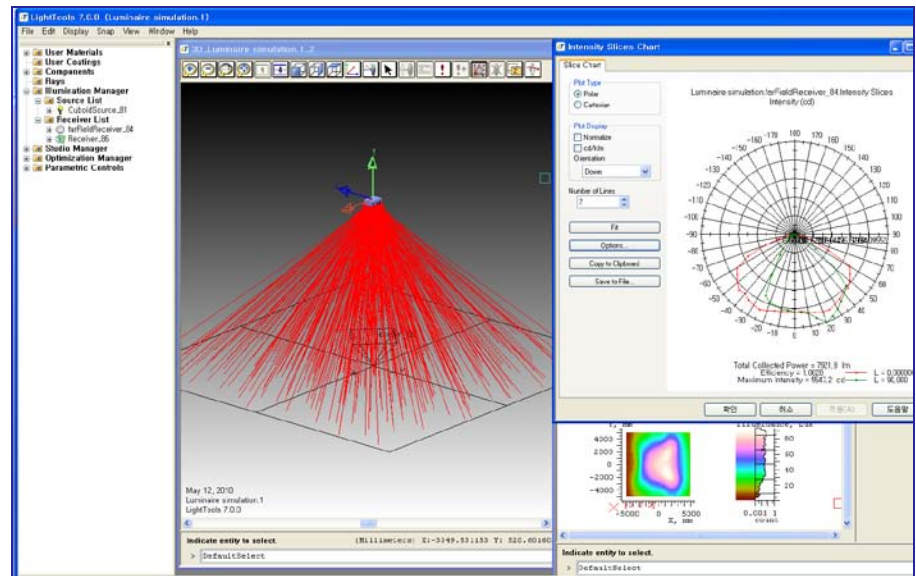
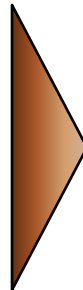
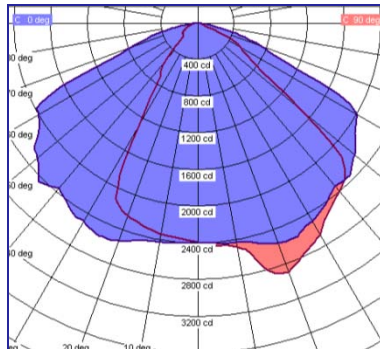
# Channel Model for Metropolitan Scenario

- Automotive VLC for Metropolitan Scenario
  - Main Operation Field (Hot Spot) for Automotive VLC Application
    - Lots of vehicles rather than other automotive application scenarios
    - Harsh multipath environment, too many interferers
    - All the light sources for automotive VLC (Head Lamp, Street Lamp, etc.) is restricted by regulation
- Our Purpose
  - Provide some insight of deciding channel type for automotive applications in metropolitan scenario
    - Include real street lamp modeling
    - Consider additional regulation distribution for street lamp

# Channel Modeling Simulation Results

# Street Lamp modeling

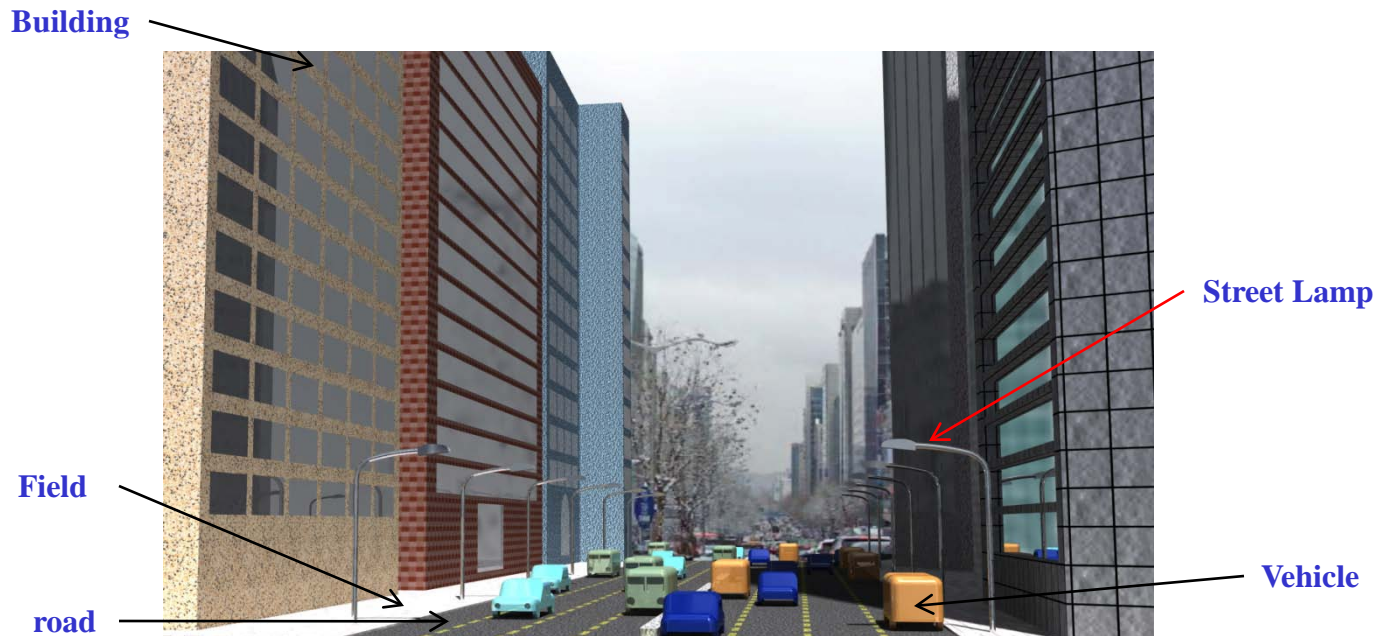
- Reference LED street lamp : LEDin-ST0-108-6K
  - total system power: 136 W
  - total luminous flux: 9300 lm



Street Lamp modeling

# Channel Modeling Scenario

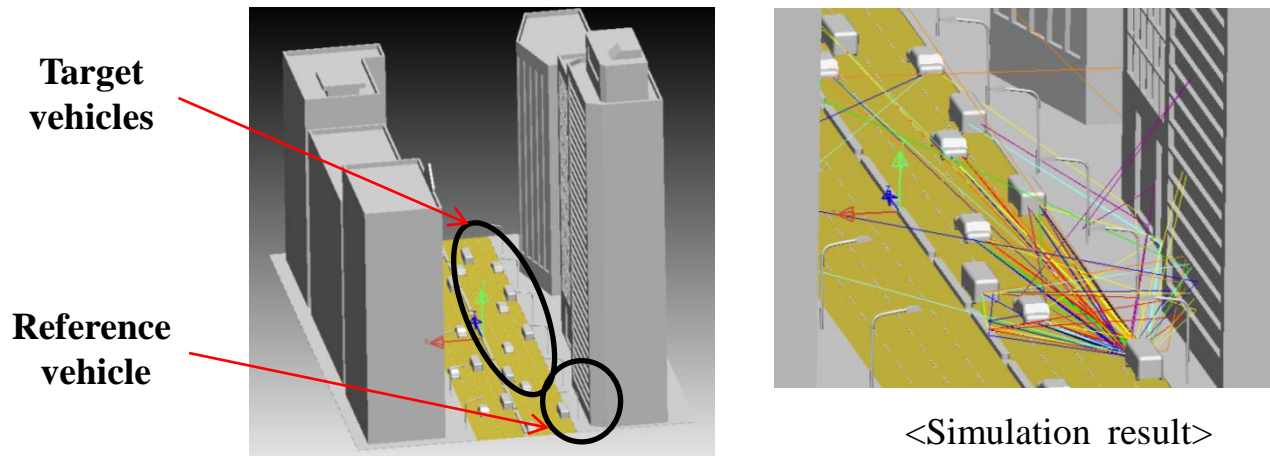
- Scenes are based on Metropolitan (Scale 1:1)
- 5 Vehicle-to-Vehicle cases
- 3 Street Lamp-to-Vehicle cases



Metropolitan modeling(rendering image)

# Modeling process (Vehicle-to-Vehicle)

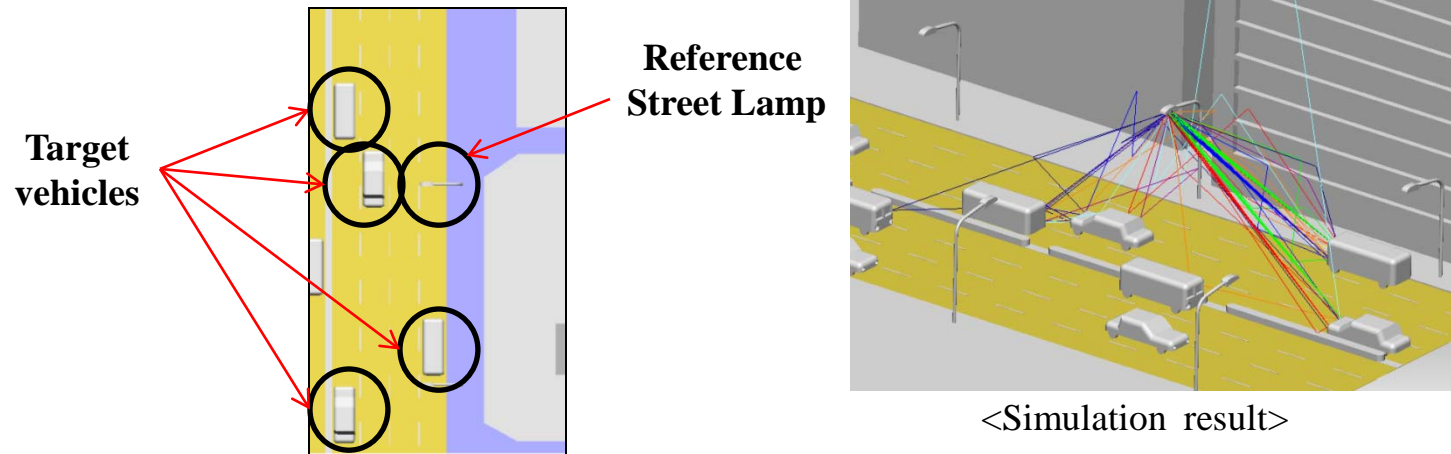
- Set reference vehicle
- Set target vehicles in the range of FOV of reference vehicle



- Operate optic simulation (use backward trace scheme)
- Extract direct/indirect ray paths
- Change reference vehicle & repeat simulations

# Modeling process (Street Lamp-to-Vehicle)

- Set reference street lamp
- By considering lamp divergence, set about 3~4 target vehicles under the reference street lamp

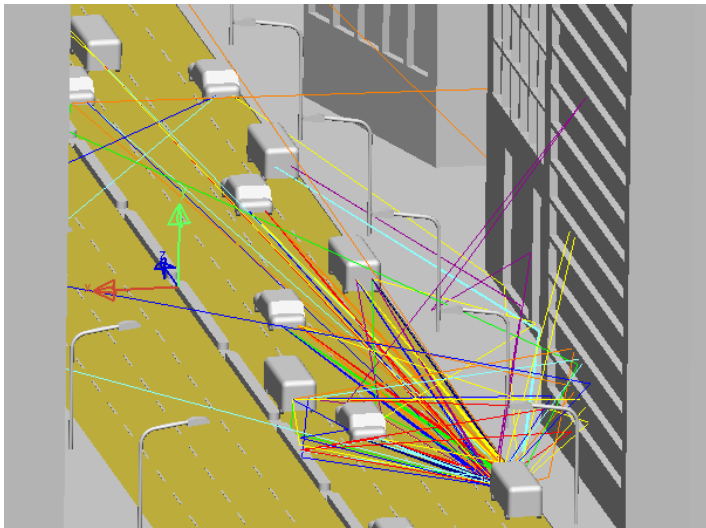


- Operate optic simulation (use backward trace scheme)
- Extract direct/indirect ray paths
- Change reference/target vehicle & repeat simulations

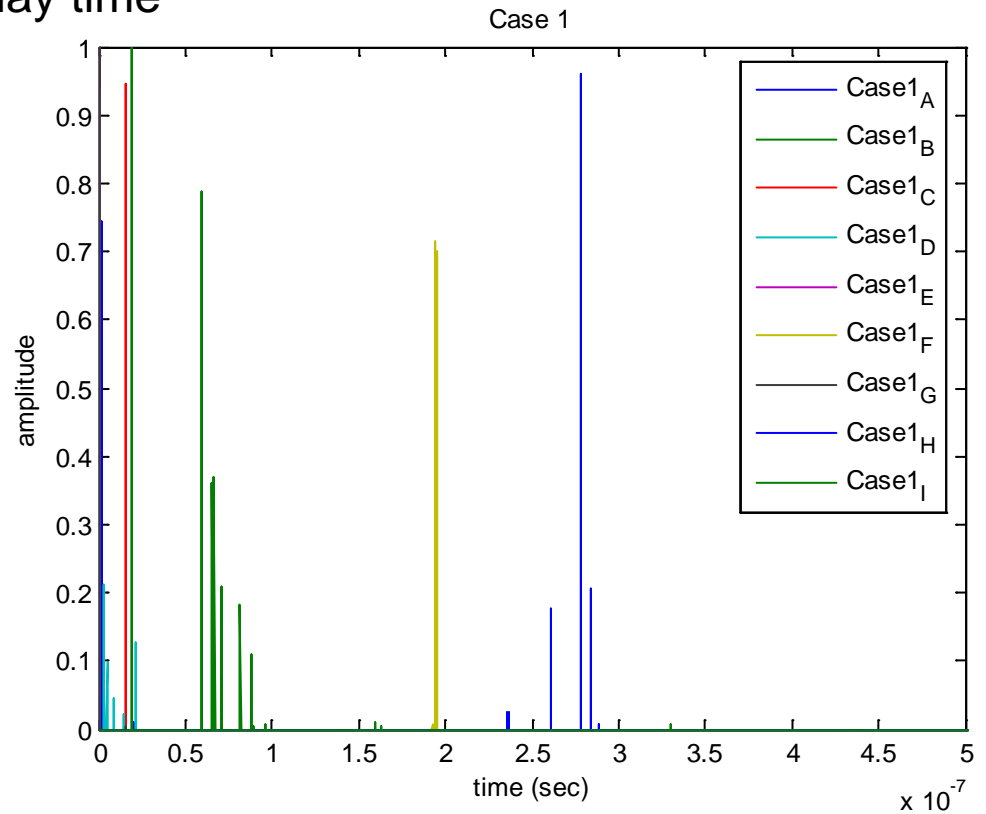


# Channel Modeling Simulation Results

- Vehicle-to-Vehicle Communication Link
  - Total 9 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time

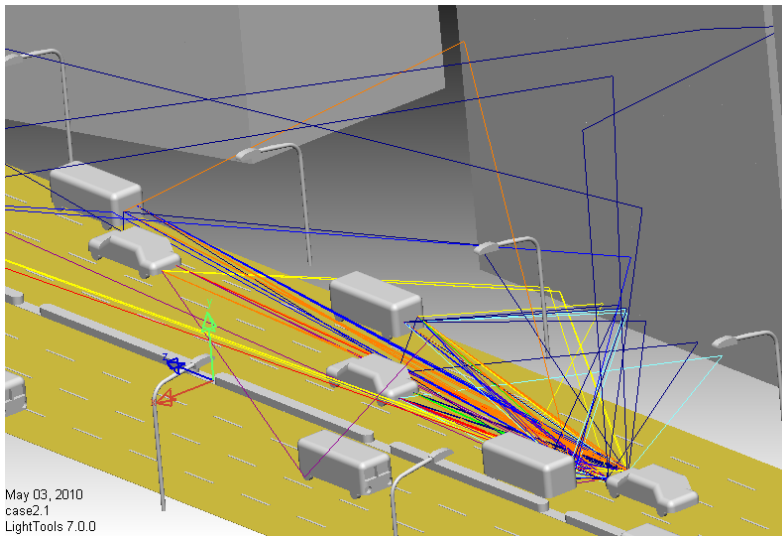


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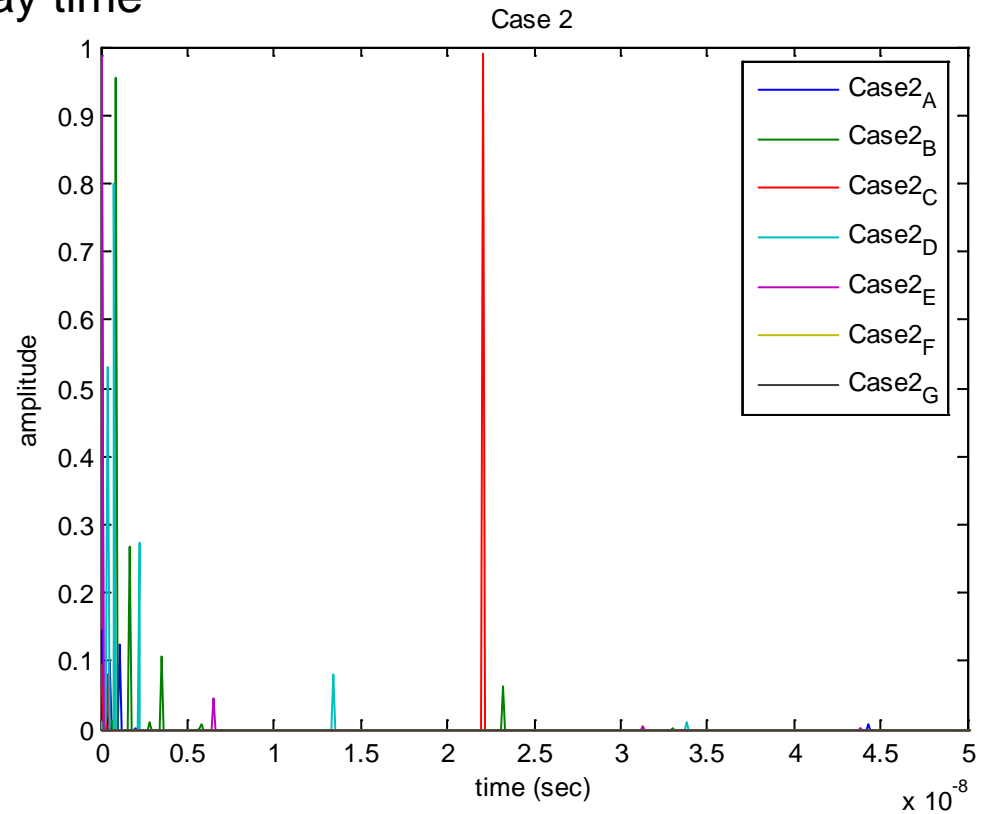
# Channel Modeling Simulation Results

- Vehicle-to-Vehicle Communication Link
  - Total 7 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time



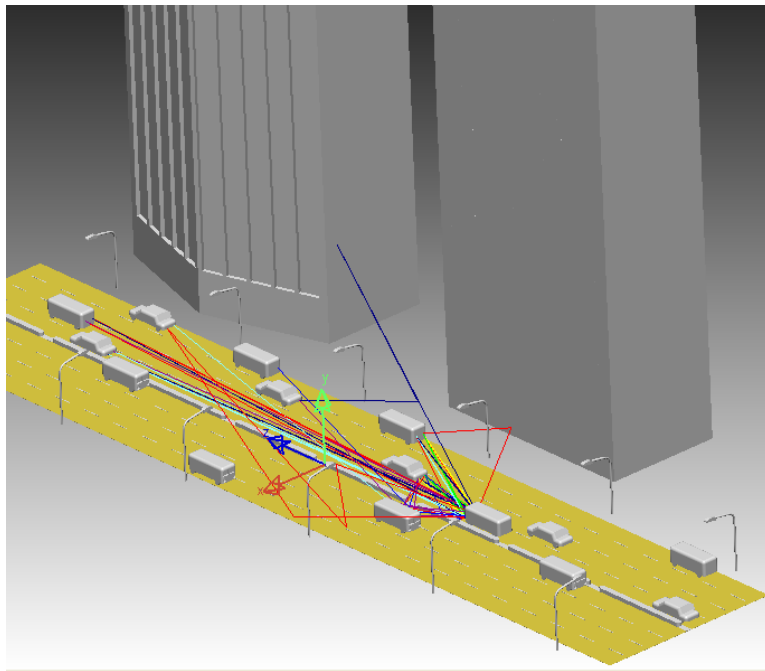
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case2.1  
LightTools 7.0.0

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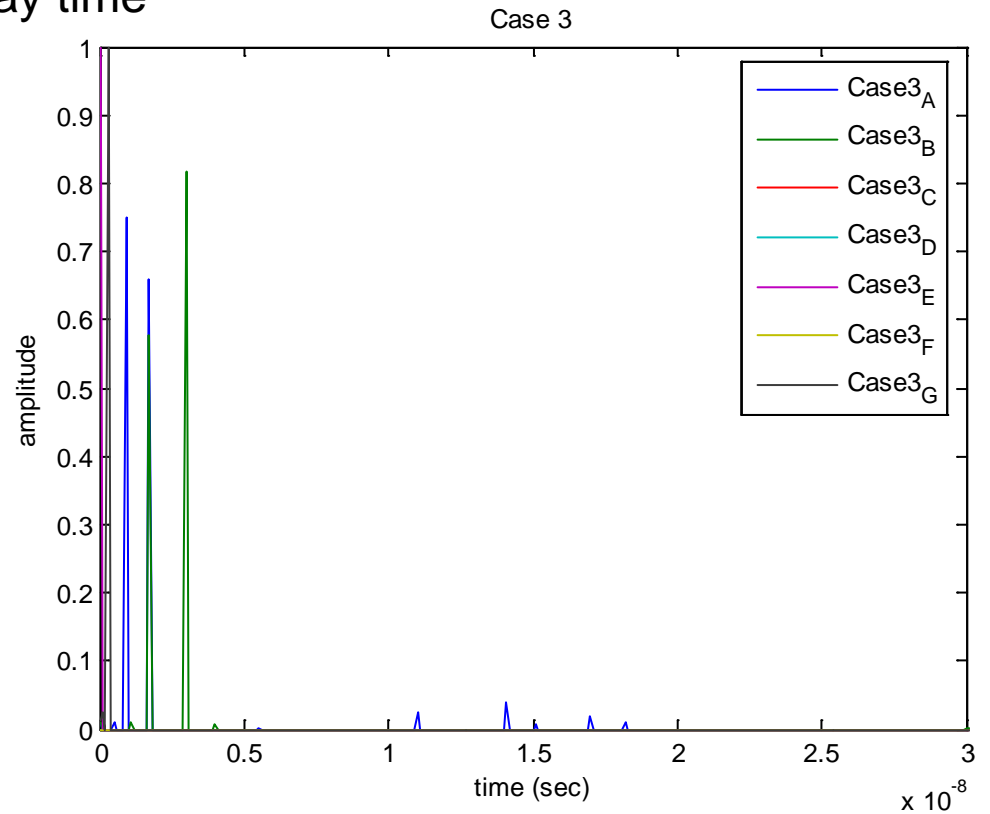


# Channel Modeling Simulation Results

- Vehicle-to-Vehicle Communication Link
  - Total 7 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time

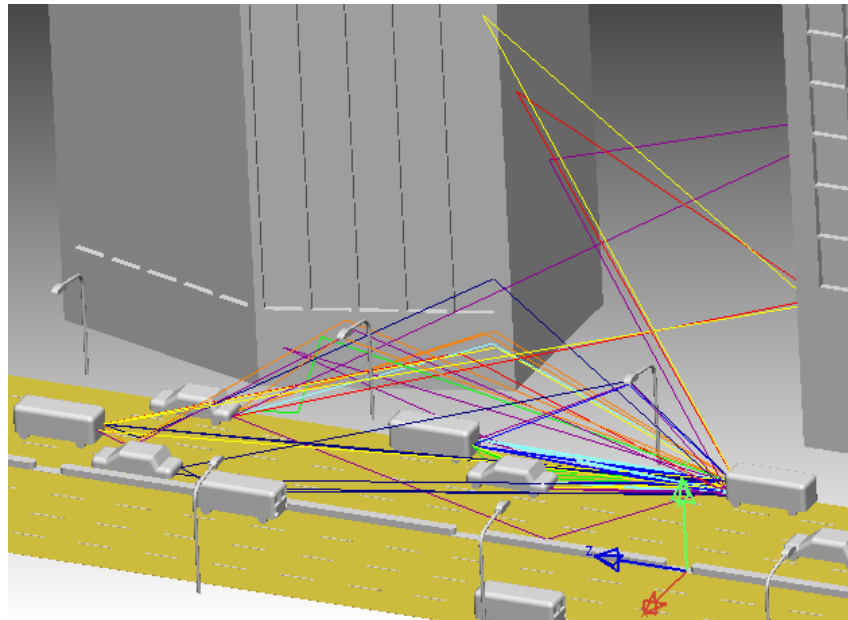


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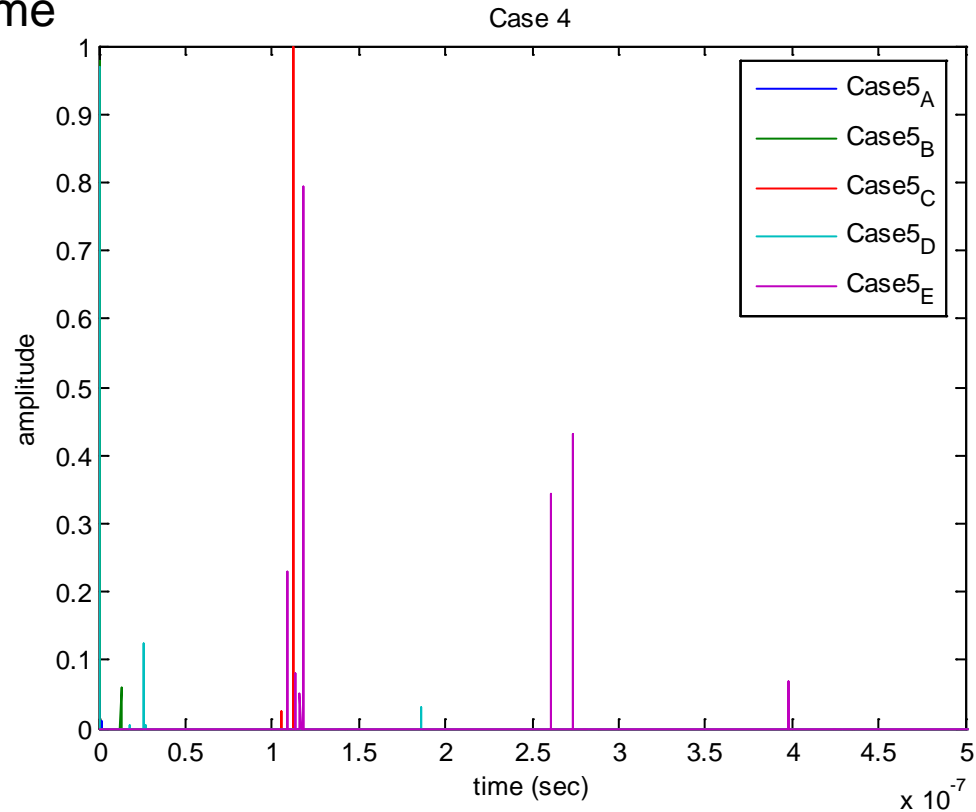


# Channel Modeling Simulation Results

- Vehicle-to-Vehicle Communication Link
  - Total 5 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time

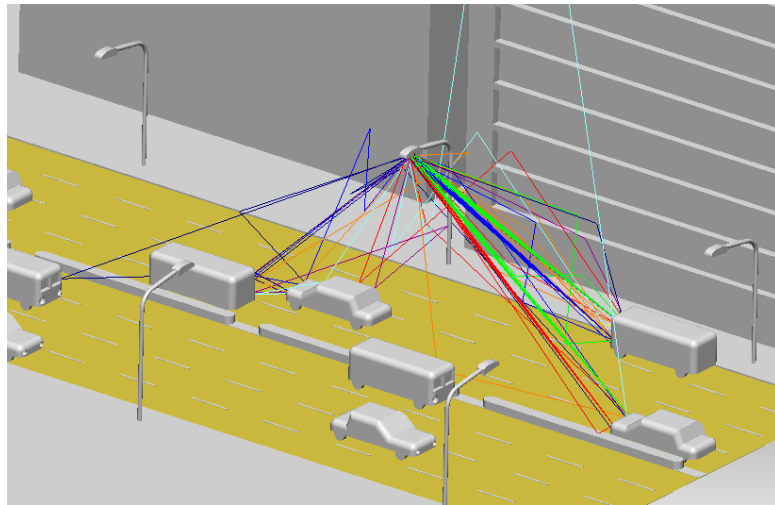


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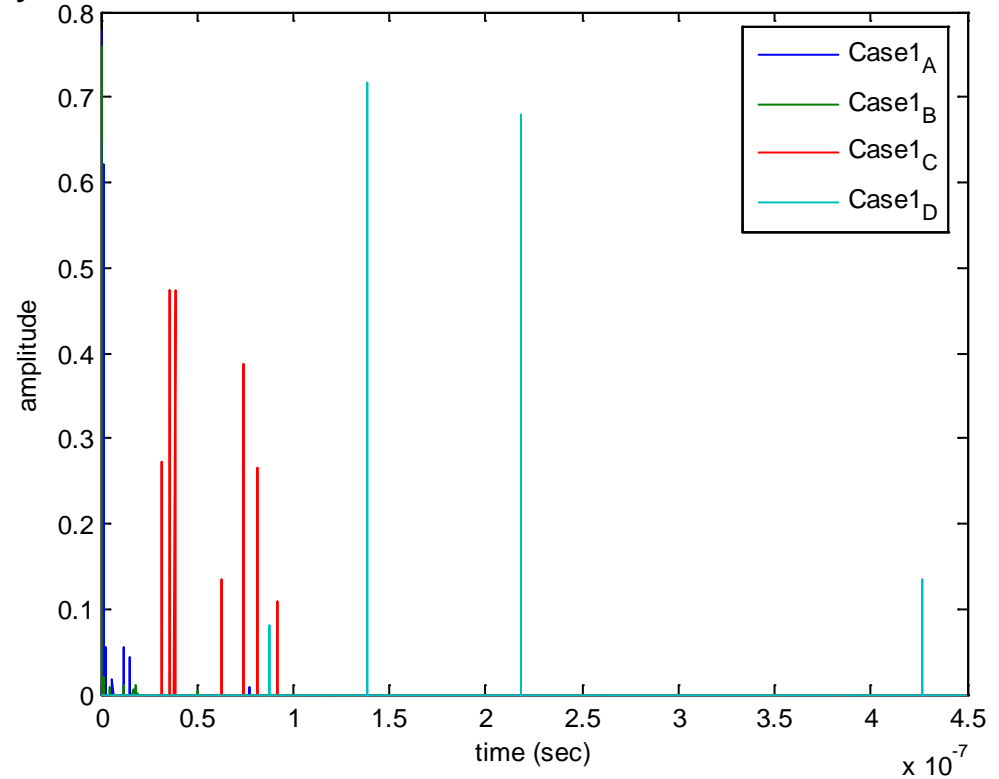


# Channel Modeling Simulation Results

- Street Lamp-to-Vehicle Communication Link
  - Total 4 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time

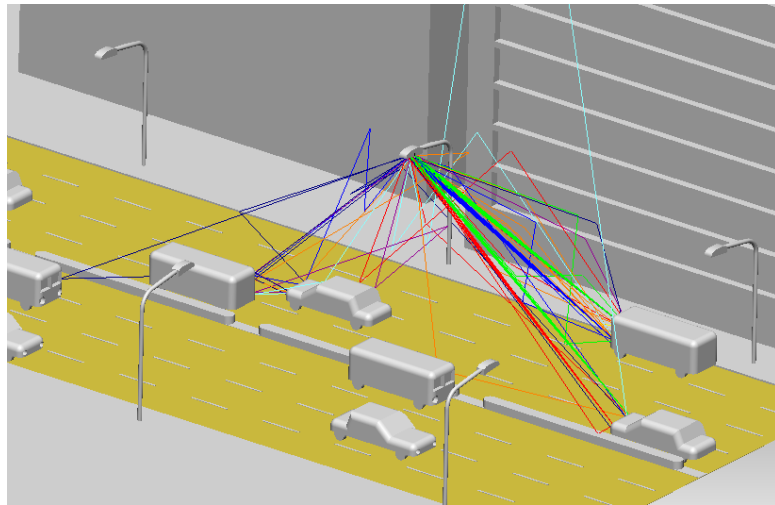


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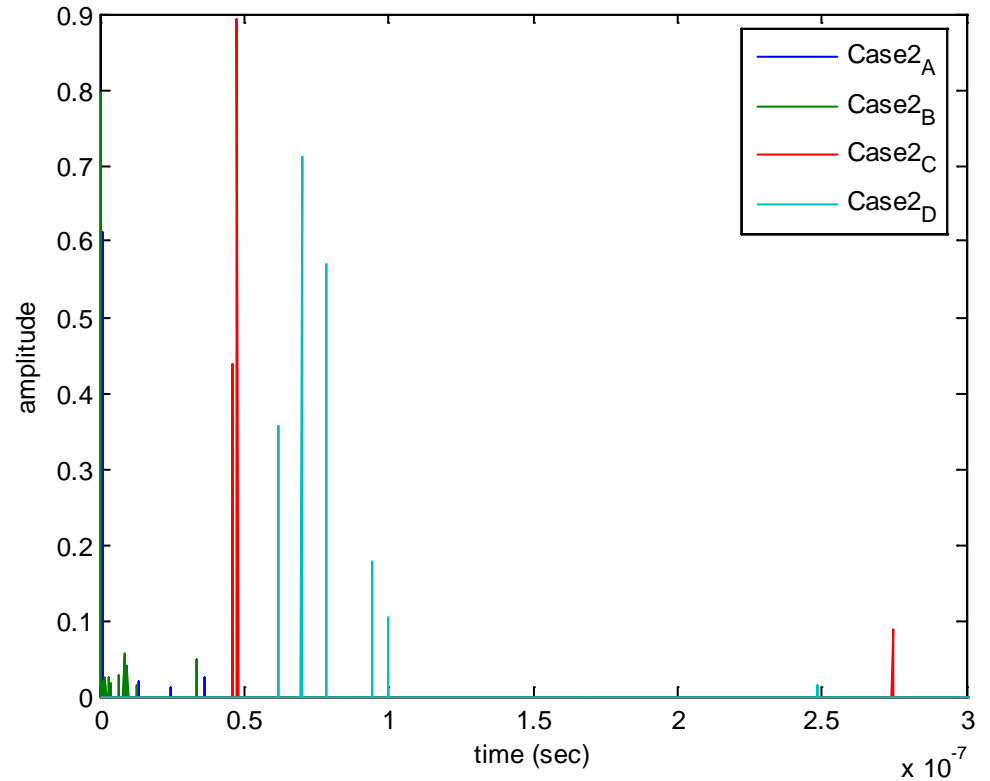


# Channel Modeling Simulation Results

- Street Lamp-to-Vehicle Communication Link
  - Total 4 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time

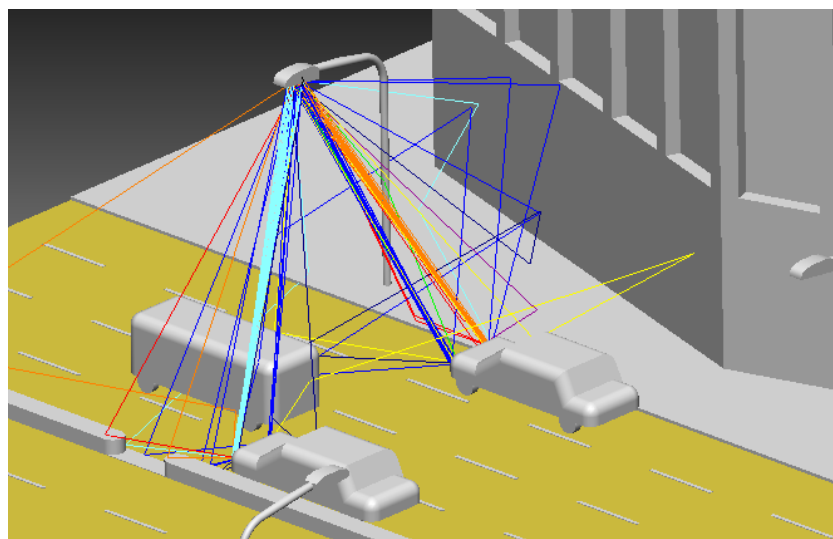


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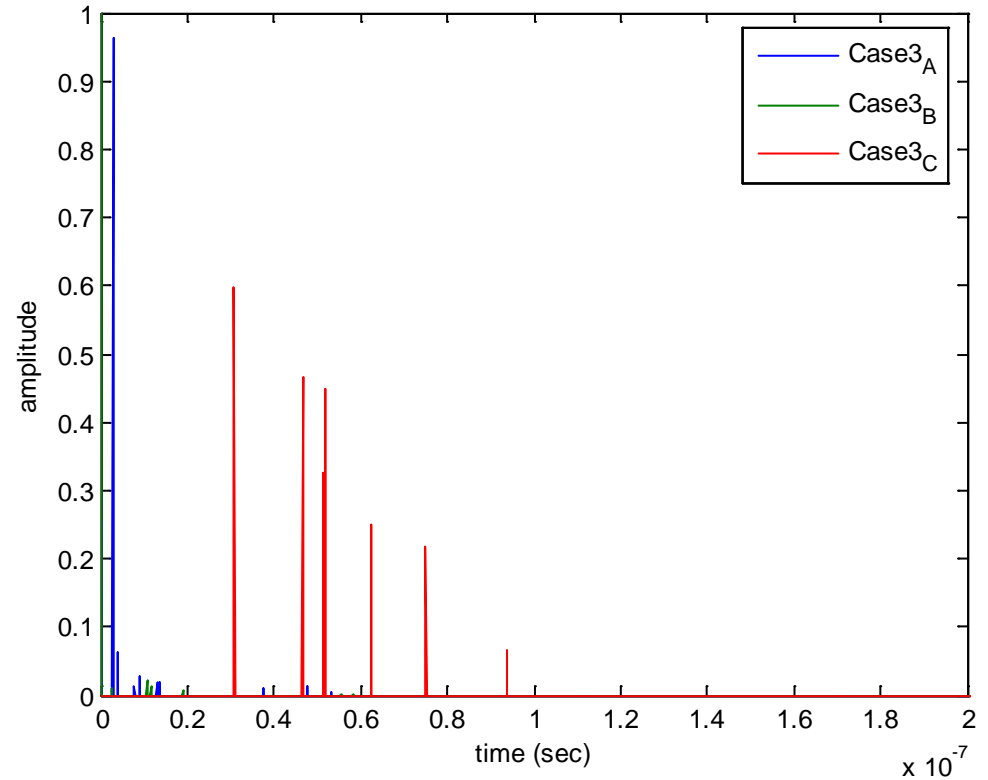


# Channel Modeling Simulation Results

- Street Lamp-to-Vehicle Communication Link
  - Total 4 sub-cases
  - Channel normalization for each cases
  - Remove propagation delay time



< Case 3 >



## Conclusions

- V-to-V Communication Link
    - Multiple LOS
    - multipath components with short delay spread
  - SL-to-V Communication Link
    - Multiple LOS
    - multipath components with long delay spread
- V-to-V & SL-to-V Can be modeled as Mixed Channel Model