KOREA UNIVERSITY

CNT Simulation

Seung Hyun Oh

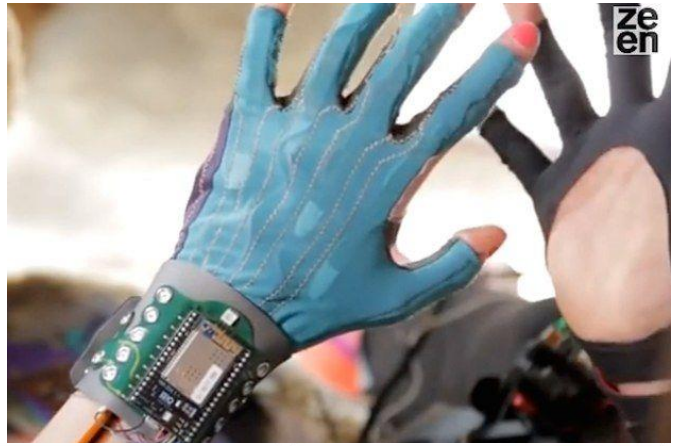
20240508

Lab for Informatics, communications and system

CNT Simulation

- **Flexible (wearable) device**

▶ 신체에 적용 가능한 디바이스에 대한 관심 증가
헬스 케어, 로보틱스 등 다양한 분야



-> Piezoresistive type strain sensor

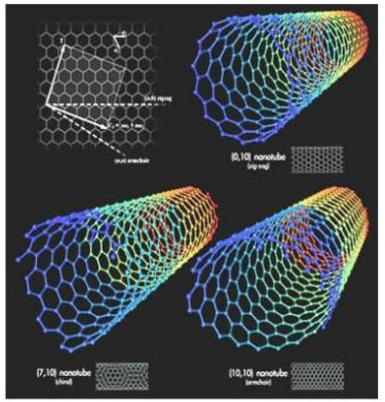
▶ 외부 기계적 변형에 의한 저항 변화를 감지

a. Filler Contact
b. Filler deformation
c. Change junction gap

-> Conductive materials

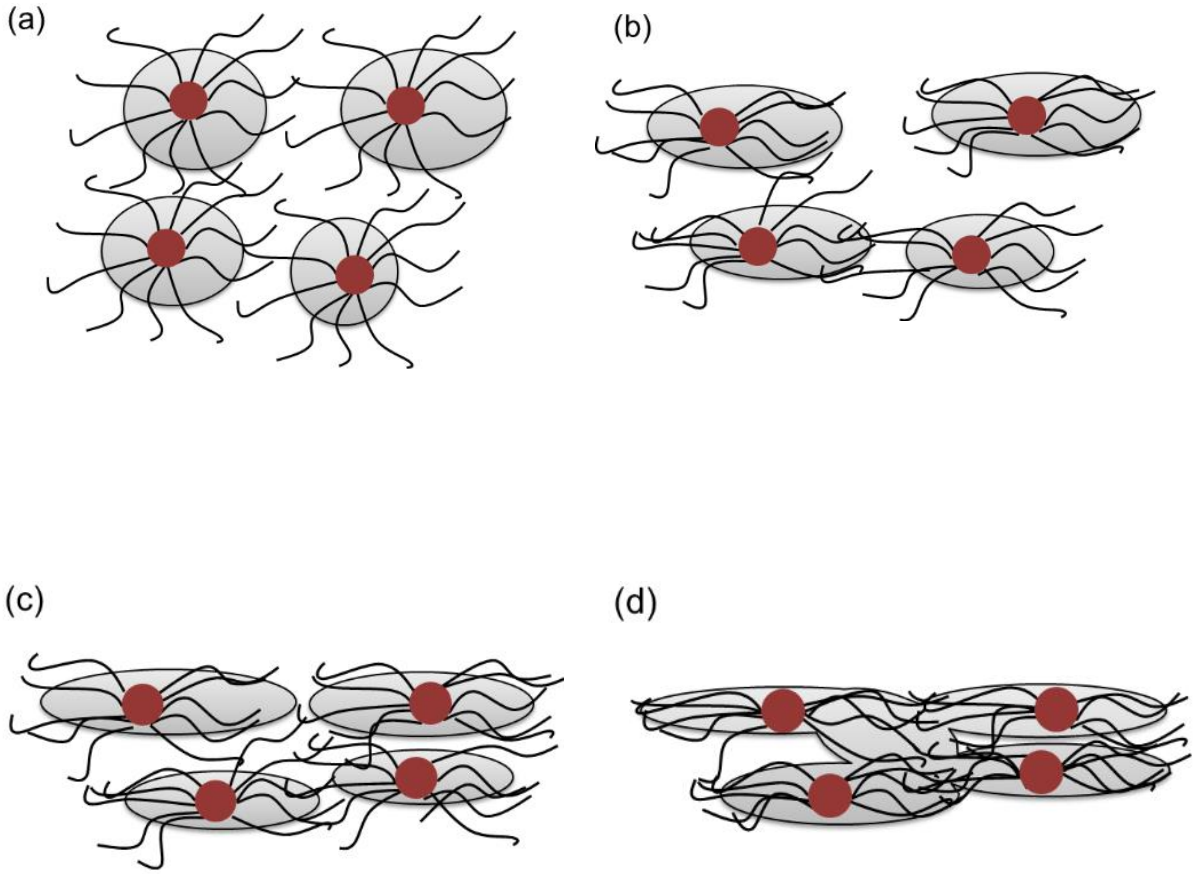
a. CNT
b. LM (Liquid Metal)
c. Lignin

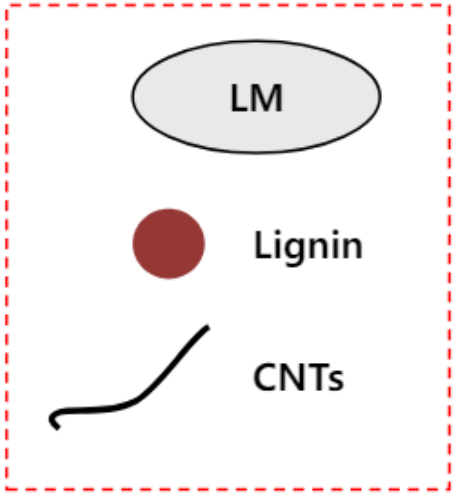
Liquid metal



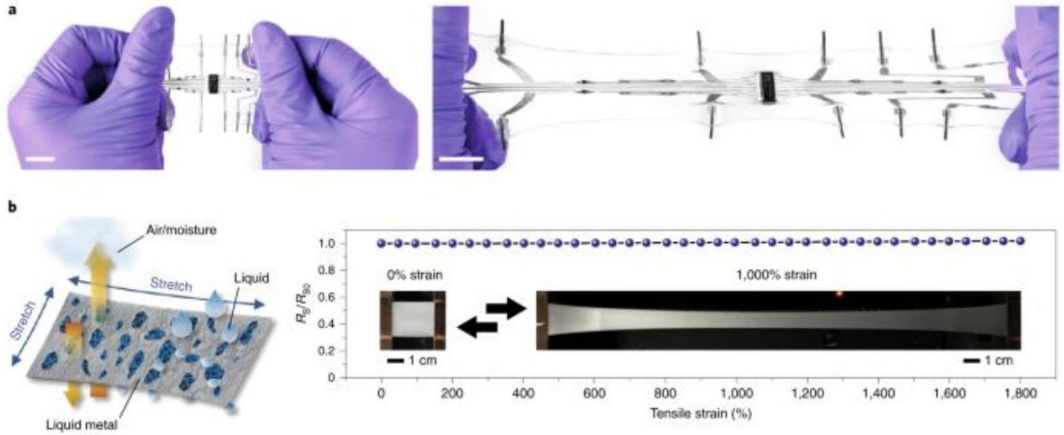
CNTs

CNT Simulation





<Lignin>



Nat. Mater. 20, 714–715 (2021).

숭실대 협업 과정 CNT (0508기준)- Aspect Ratio에 따른 전기전도도

CNT Aspect Ratio(길이/직경) 정보

1. Short CNT: 약 600 (길이 15㎛)
2. Long CNT: 약 40,000 (길이 800㎛)

※ CNT 직경은 동일

고분자: PDMS (polydimethylsiloxane) - 실리콘

	전기전도도(S/m)	
Short CNT	0.362	13.218
Long CNT	10.055	102.373

- CNT가 길수록 복합체의 전기전도도 높음 (CNT contact point 증가)
- CNT의 함량이 많을수록 복합체의 전기전도도 높음 (CNT contact point 증가)

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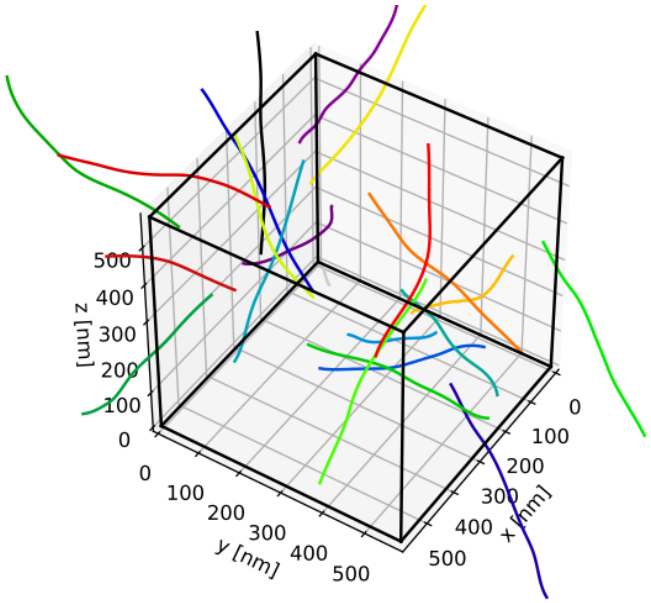
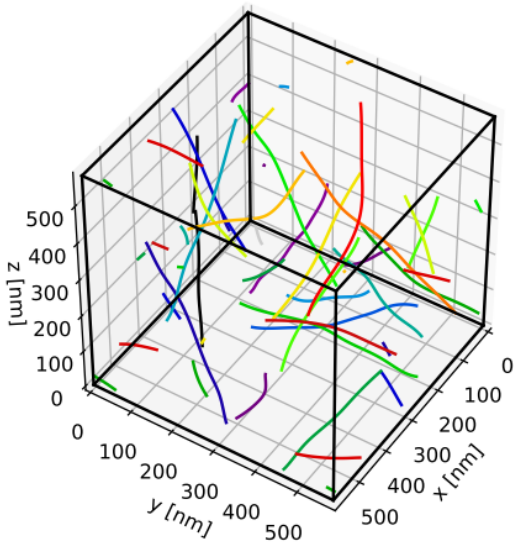
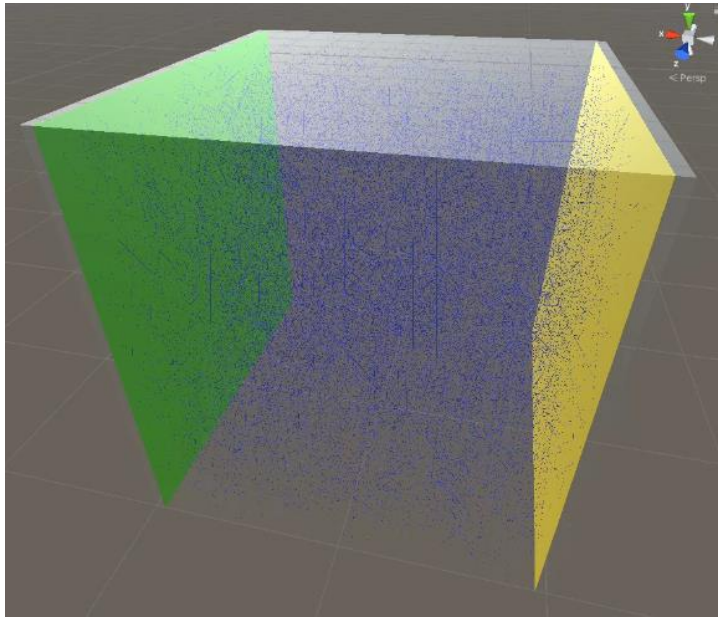
Static & Extension Simulation 진행상황

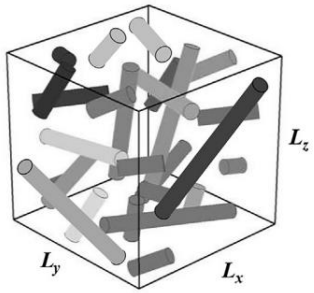


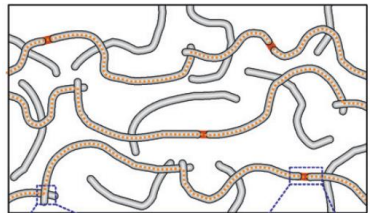




- 기존 실험에서는 Silica로 인한 Reflection 효과로 CNT Contact Point가 증가했음
- Silica가 없으면 Flat Fiber 형태로, Contact Point가 증가하지 않을 수 있음

<실험 변경 사항>
- 길이에 따라 Segment를 나눠 랜덤한 각도로 휘게 실험





인장에 따른 전기적 저항 변화

CNT Aspect Ratio(길이/직경) 정보

1. Short CNT: 약 600 (길이 15㎛)
2. Long CNT: 약 40,000 (길이 800㎛)

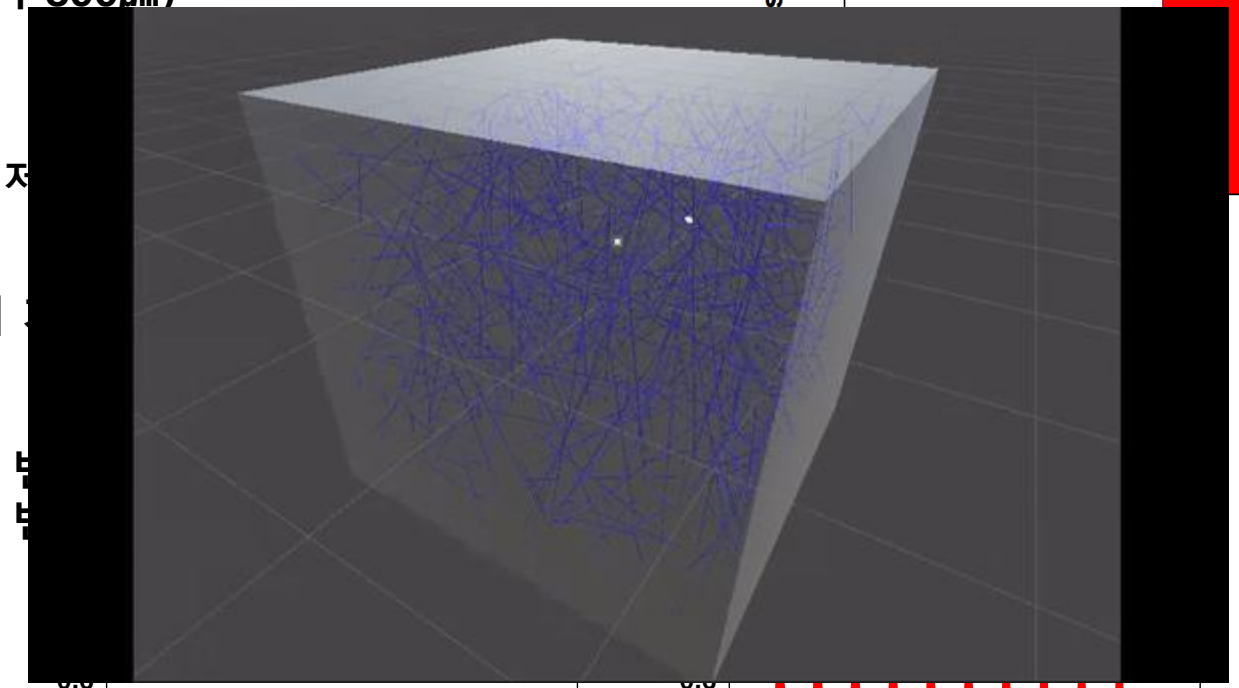
최대 인장 80%

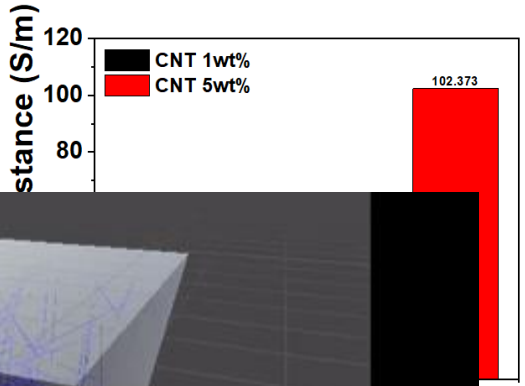
10 cycle 진행(한 사이클 30초)

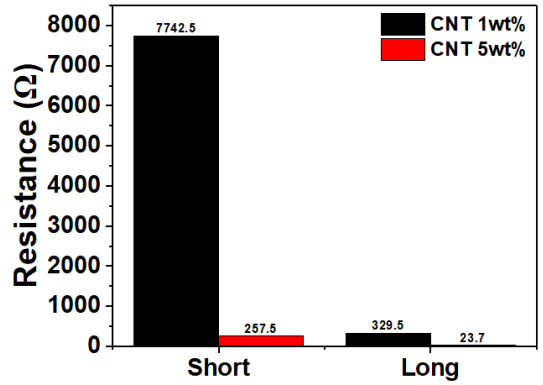
$\triangle R/R_0$ = (저항 – 초기저항) / 초기저

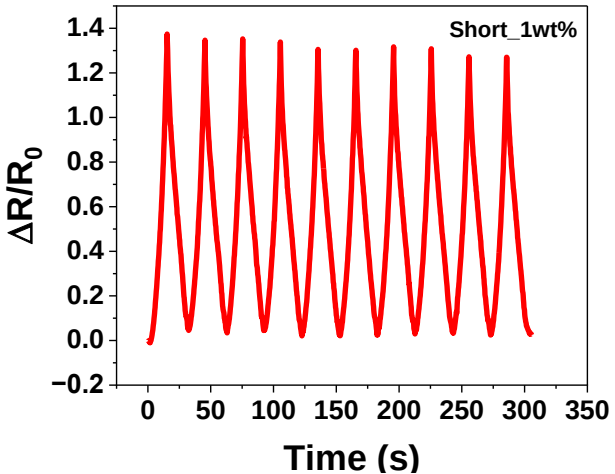
CNT 복합체 인장 시, CNT간의

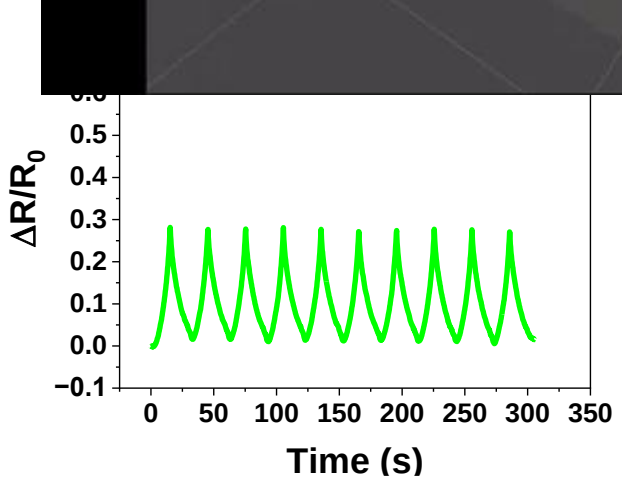
- CNT 길이가 짧을수록 저항
- CNT 함량이 많을수록 저항

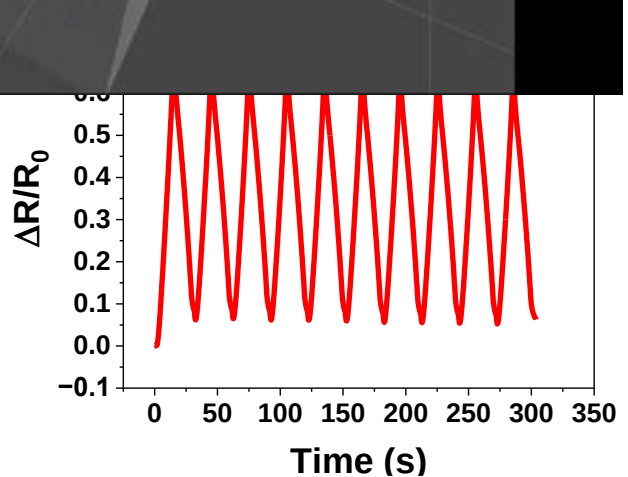


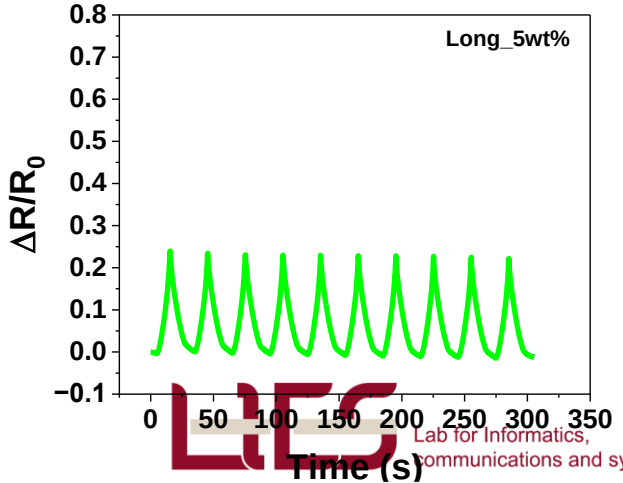










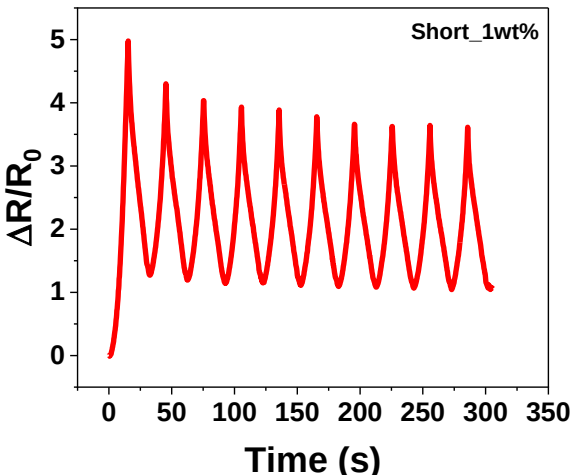


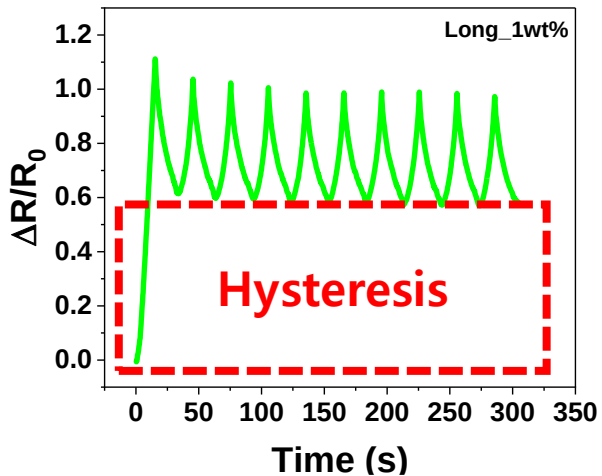
인장에 따른 전기적 저항 변화

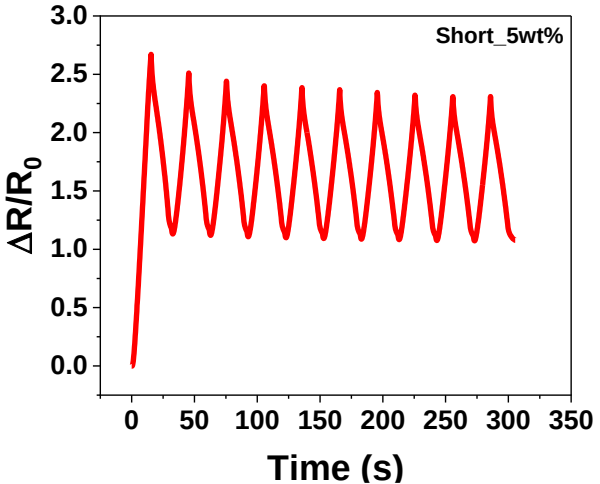
CNT 복합체 인장 시험 시, 10회의 pre-cycle 진행

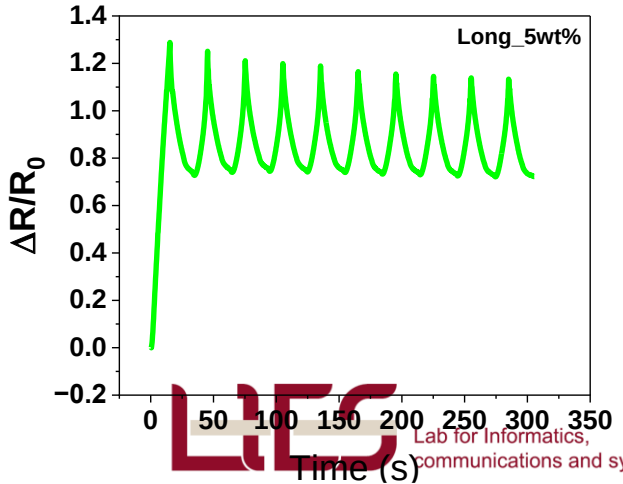
- Hysteresis 제거
- Random하게 정렬되어 있던 CNT의 배열에 인장으로 인한 약간의 방향성 형성
- Pre-cycle 이후 안정적인 signal

➔ 시뮬레이션 예측 시, Pre-cycle이 완료되었다고 가정하고 진행
➔ 만약 Hysteresis 제거까지 구현이 가능하다면 추가하면 퀄리티가 매우 좋아질 것이라 예측되지만 급한 사항은 X

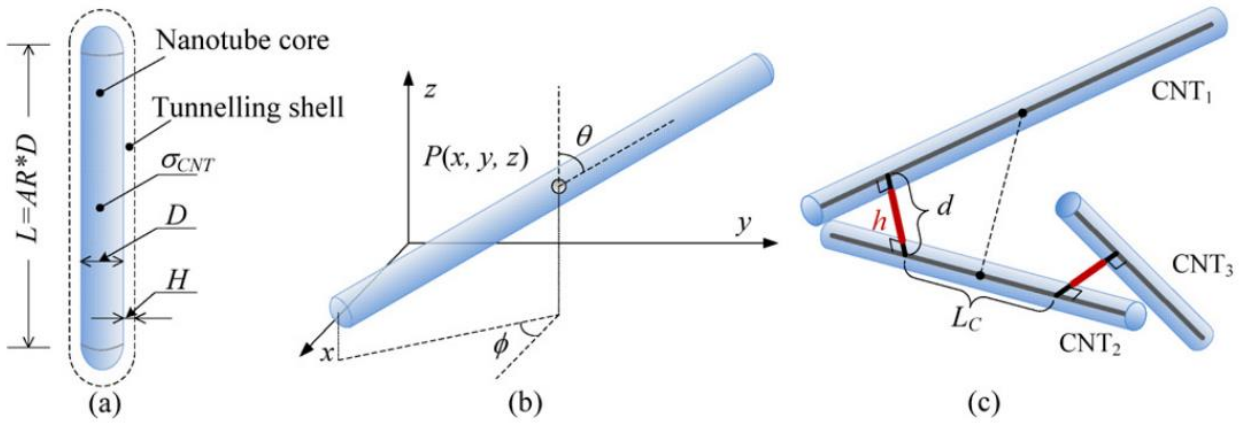








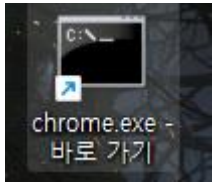
Tunneling Effect Issue

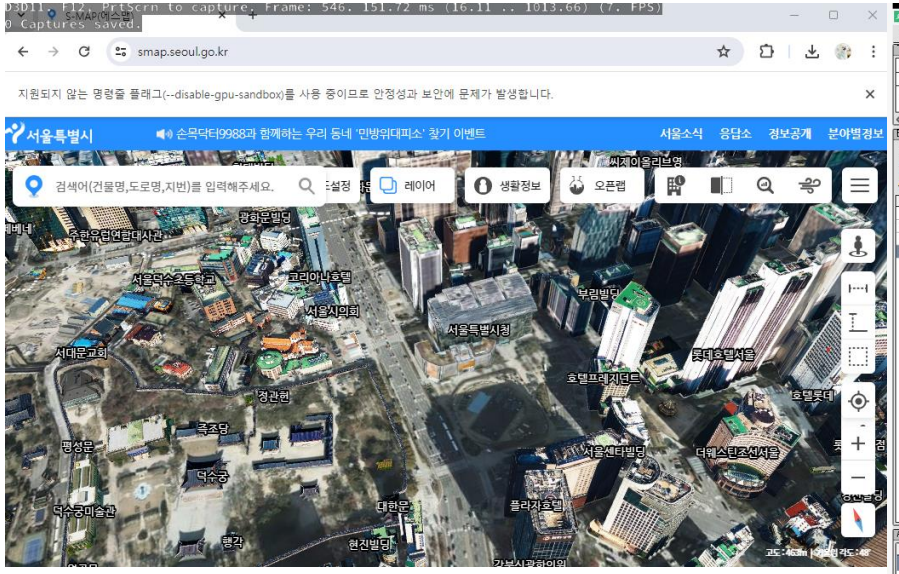


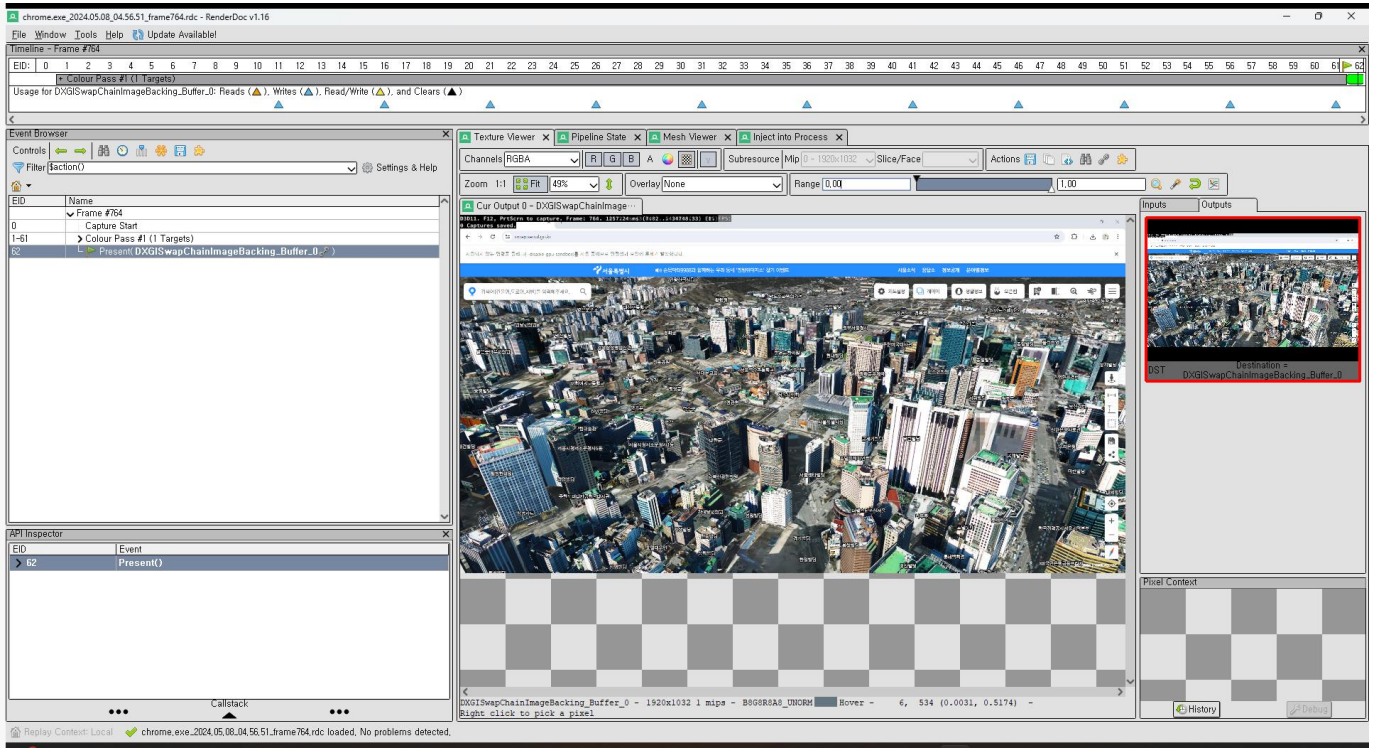
터널링 효과를 제거한 Conductivity를 계산 (숭실대에서 요청하셨습니다.)

- **오로지 Contact Point를 기준으로 Contact Point만 많아질 수록 Conductivity가 증가하기를 바람**
- **특히 Extension Simulation의 경우, Tunneling 효과를 구현하기가 너무 까다로워, 다른 시뮬레이션의 거의 모든 논문에서 배제한다고 함**

PS


chrome.exe -
바로 가기


smap.seoul.go.kr
지원되지 않는 명령줄 플래그(--disable-gpu-sandbox)를 사용 중이므로 안정성과 보안에 문제가 발생합니다.
서울특별시
검색어(건물명,도로명,지번)를 입력해주세요.
레이어
생활정보
오픈랩
서울소식
응답소
정보공개
분야별정보


chrome.exe_2024.05.08_04.56.51_frame764.rdc - RenderDoc v1.16
File Window Tools Help Update Available!
Timeline – Frame #764
Event Browser
Texture Viewer
Pipeline State
Mesh Viewer
Inject into Process
API Inspector
Present()
Pixel Context

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