MULTI-SCALE COMPUTATIONAL VISUALIZATION OF ANGLE DEPENDENT AND ROUGHNESS-SENSITIVE PLASMONIC STRUCTURAL COLORATION

WEI SEN LOI, KENNETH CHAU

THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Applied Science
School of Engineering
Okanagan Campus

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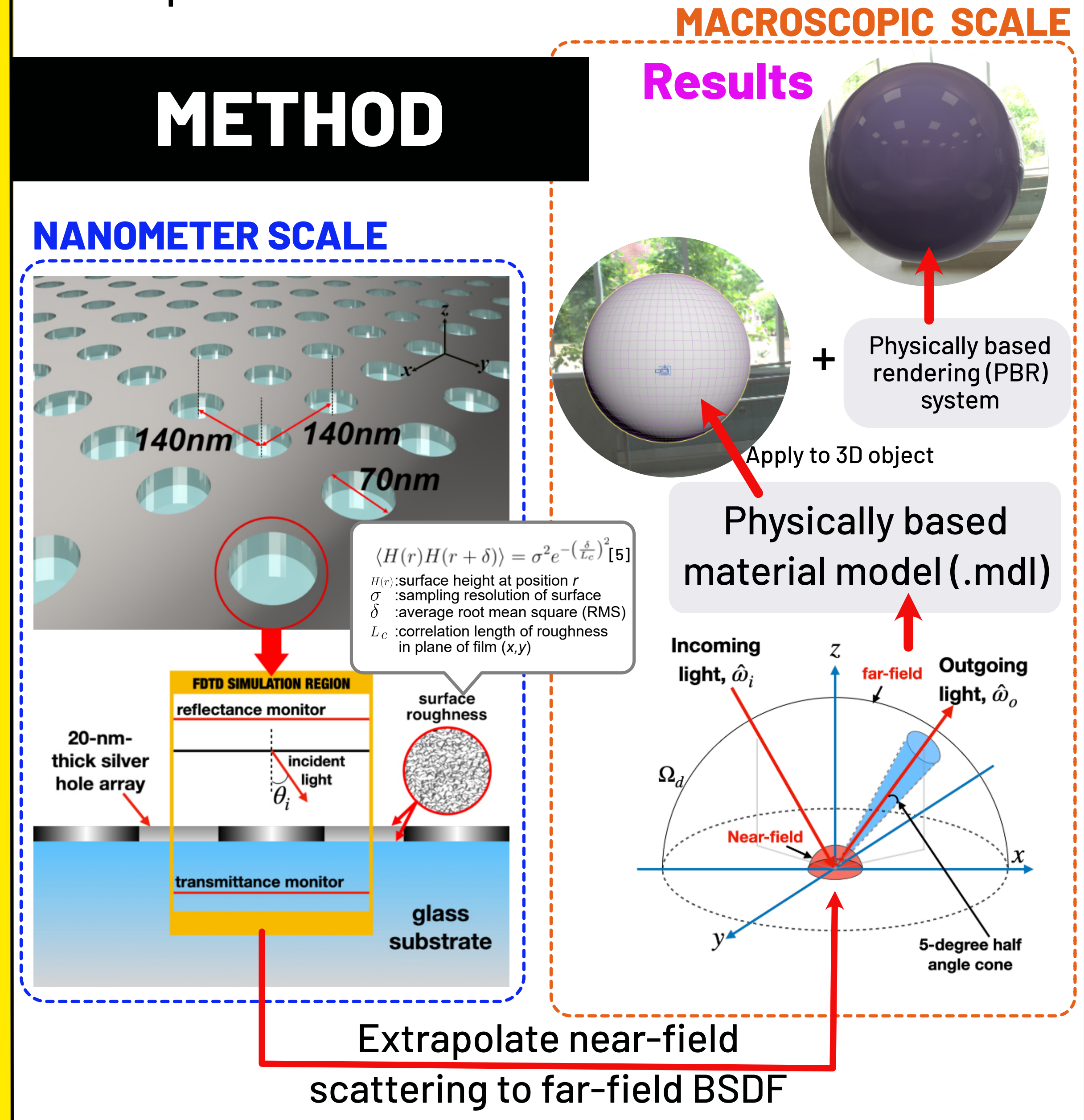
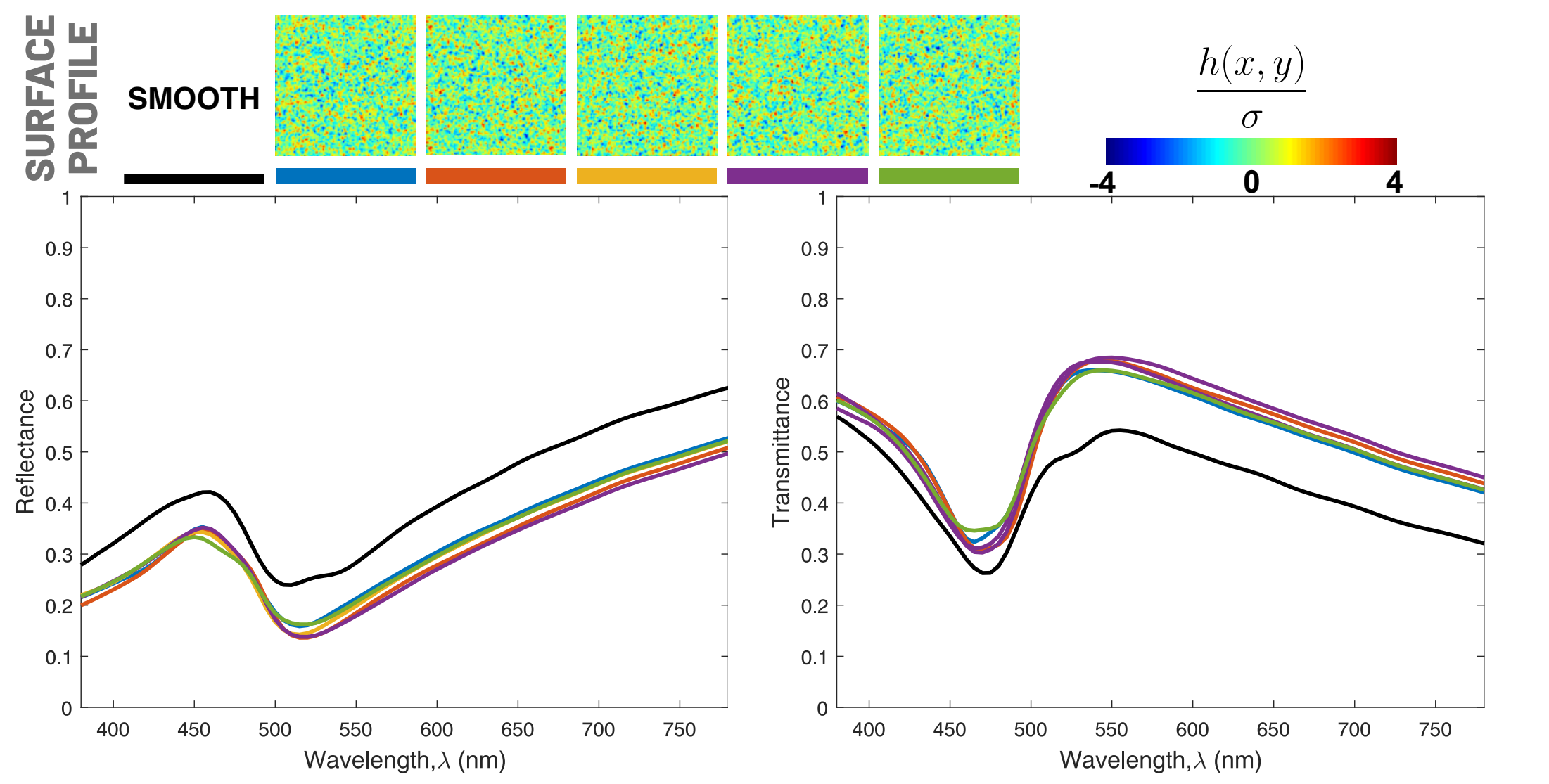
PROBLEM

- Fabricated plasmonic nanostructures exhibit roughness which can lead to deviations in its colors and performance compared to those predicted from simulations [1].
- Roughness occurring at nanometer size scales can perturb surface plasmon resonances and affect both the far- and near-field electromagnetic field patterns associated with the plasmonic structure.

METHOD



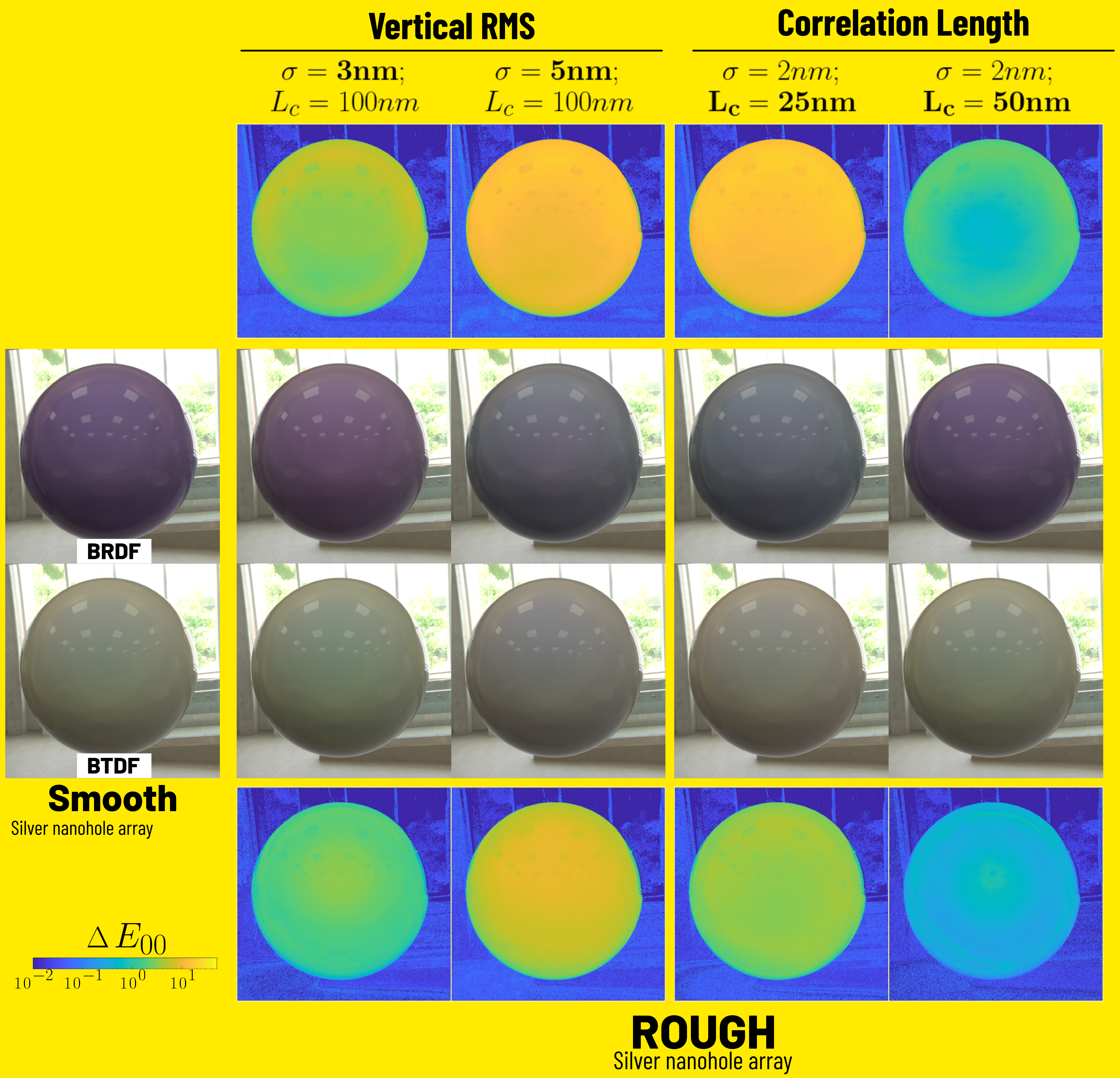
RESULTS



Normal-incidence reflectance and transmittance spectra of smooth and rough (5 surface profile with identical vertical RMS = 2nm and correlation length =15nm) silver nanohole array.

- Roughness decreases the reflectance of array cross the visible spectrum by about 10% and increases transmittance above 520nm by about 15%.
- These observations are consistent with previous reports of enhanced surface plasmon coupling into plasmons and associated transmission enhancement[6].

Visualize the effects of nano-scale roughness sensitive on plasmonic structural coloration using multi-scale electrodynamic simulation and physically based rendering.



Scan QR code to preview the structural color in the virtual showroom.
[SEE AT THE CONTACT SECTION]

YOUR APPROACH

- Capture the far-field bidirectional scattering distribution (BSDF) of plasmonic nanostructures (silver nanohole array) due to nano-scale roughness using finite-difference time domain (FDTD) simulations.
- Create physically based material model (.mdl) based on the far-field BSDF and render the appearance using modern PBR system.
- Analyze the color difference between smooth and rough silver nanohole array by Delta E, ΔE_{00}.

RELATED WORK

- Iridescence of *Morpho* butterfly wings [2], *Elaphe* snake skin[3] and soap bubbles [4] had been model and rendered using wave-optical physically based rendering.
- Current PBR cannot capture structural color from plasmonic nanostructures, as their color is governed by electromagnetic interactions occurring at 10s nanometers.
- New scattering model required a multi-scale computational model that incorporating electrodynamic simulations and PBR to physically describe the effect of nano-scale roughness on structural coloration arising from plasmonic nanostructures at life-scale.

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SCAN ME

Preview coated plasmonic structural colors in virtual showroom.

Wei Sen Loi
https://www.vincentloi.com
Kenneth Chau
https://people.ok.ubc.ca/kennchau/
weisen.loi@alumni.ubc.ca
kenneth.chau@ubc.ca