

Simplified Equivalent Circuit Models for Waveform-Selective Metasurfaces Responding to Repeated Pulses

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Metasurfaces enable us to readily tailor electromagnetic properties and thus control electromagnetic waves and related phenomena by carefully designing subwavelength unit cells [1]. The electromagnetic response of metasurfaces can change in accordance with frequency, while the response remains unchanged at the same frequency. In recent years, circuit-based metasurfaces were reported to be capable of varying electromagnetic response even at the same frequency in response to the incoming waveform or more specifically to the pulse width [2]. Such waveform-selective metasurfaces were expected to give us an additional degree of freedom to control electromagnetic waves. However, the relationship between their response and design parameters including lumped circuit components remained unclear, in particular, when the structures were repeatedly illuminated by a series of pulses. In this study, we propose simplified equivalent circuit models to readily estimate and explain how waveform-selective metasurfaces operate with repeated pulses as shown in Figure 1. The proposed equivalent circuit models are obtained by considering the lumped circuit components that are solely biased by the direct-current (DC) component generated by the rectification mechanism of diodes [3]. These equivalent circuit models are found to show limited deviation of approximately 5 % from numerically derived results. In this talk, we will present additional examples to evaluate the performance of our proposed approach with a wide range of circuit parameters and other types of waveform-selective metasurfaces, which will be also validated by measurement results.

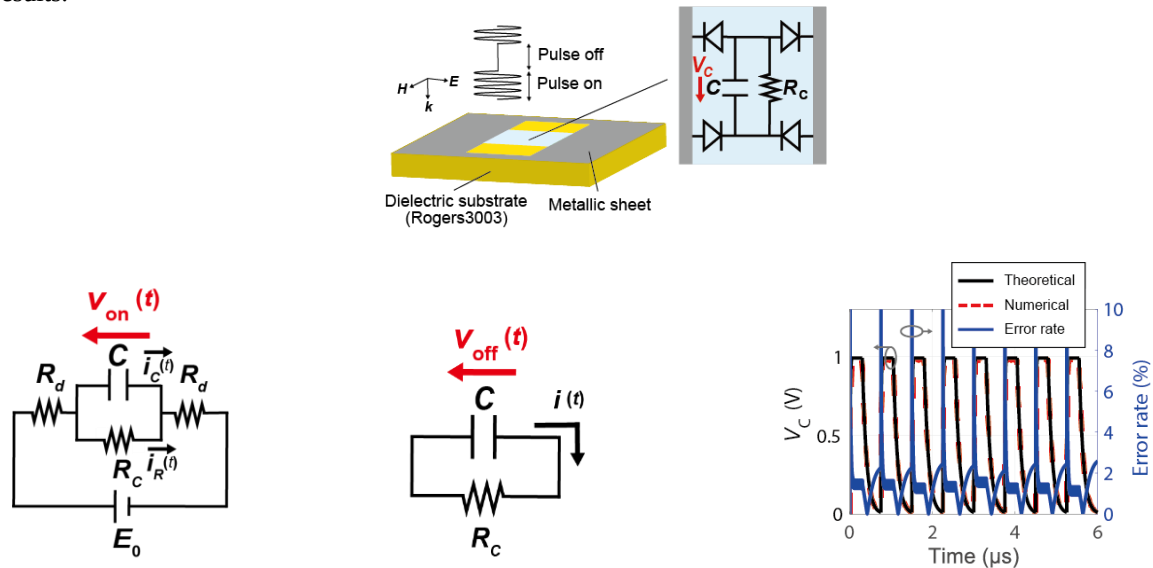


Figure 1. (Top) Periodic unit cell of waveform-selective metasurface and (bottom left to center) proposed equivalent circuit models during and between pulse illuminations. (Bottom right) Comparison between theoretically derived voltage value and numerical calculation result.

References

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