Title

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***Abstract*—Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante.**

***Index Terms*—Earth conduction effects, electromagnetic transients, frequency-dependent soil models, overhead lines.**

I. Introduction

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II. Mathematical Model

A. Earth impedance and admittance formulas

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B. Frequency-dependent soil model

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III. Propagation Characteristics

A. System configuration

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B. Modal analysis

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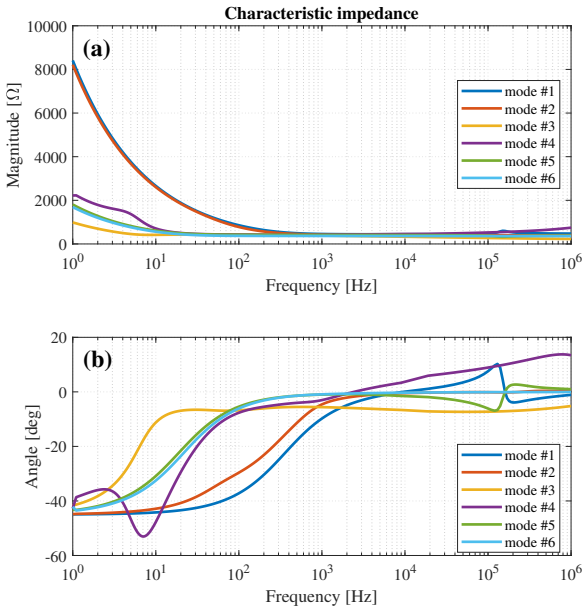

Fig. 1. Characteristic impedance magnitude (a) and angle (b), Wise's formula, constant soil parameters with $\rho = 1000\ \Omega$.m.

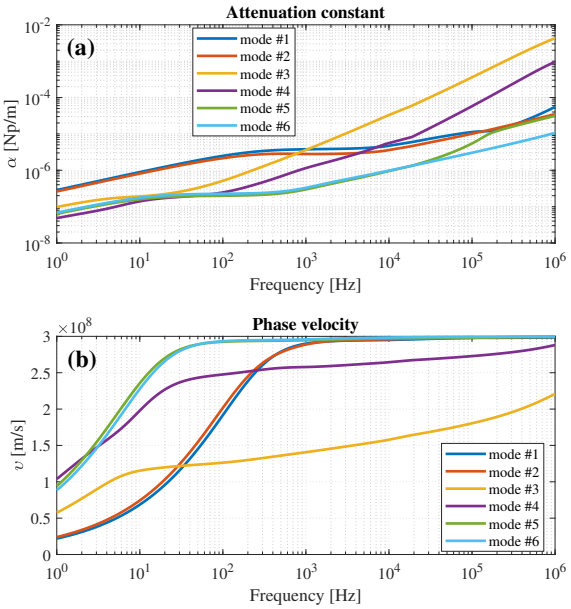

Fig. 2. Attenuation constant (a) and phase velocity (b), Wise's formula, constant soil parameters with $\rho = 1000\ \Omega$.m.

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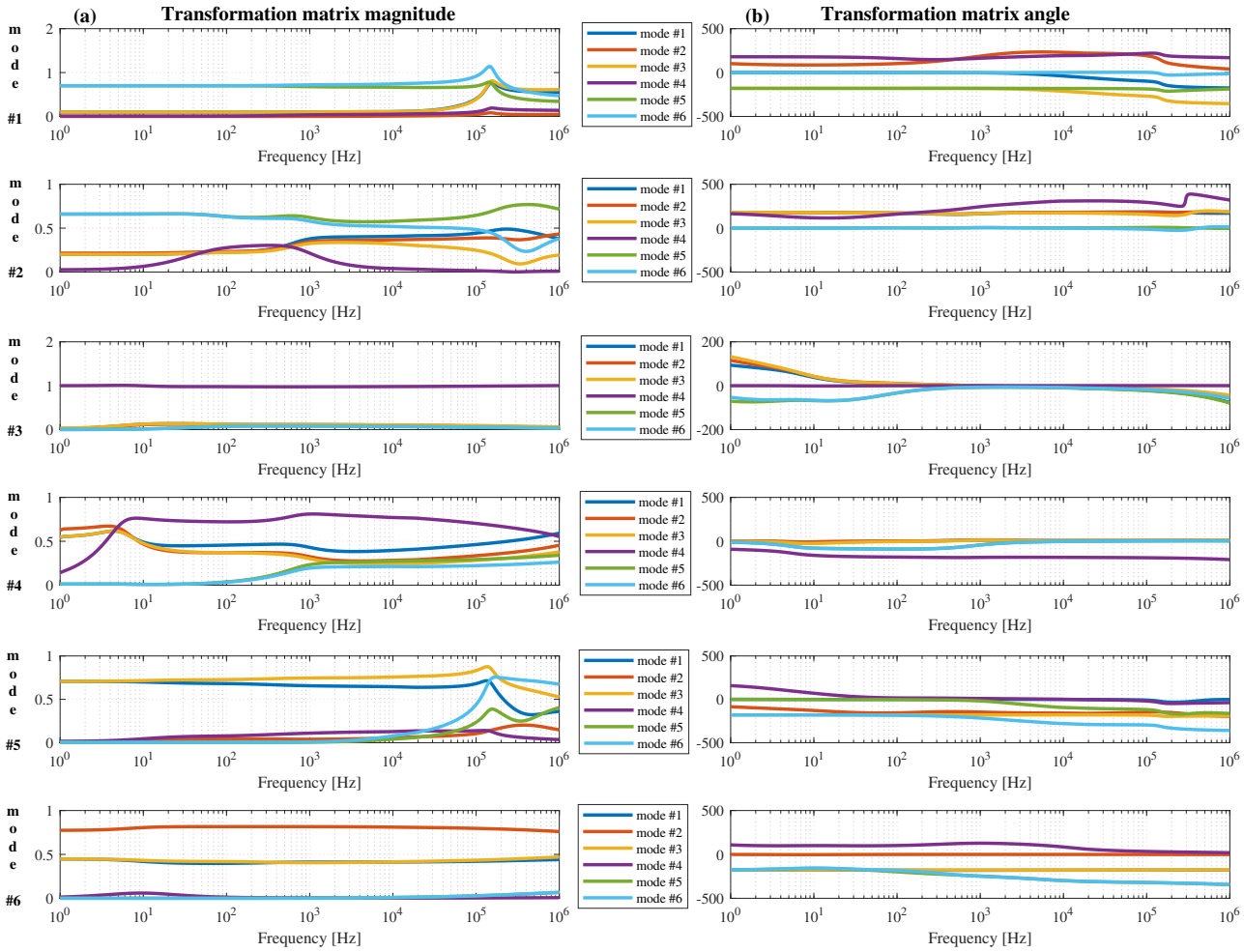

Fig. 3. Modal transformation matrix magnitude (a) and angle in degrees (b), Wise's formula, constant soil parameters with $\rho = 1000\ \Omega$.m.

C. Influence of earth admittance correction

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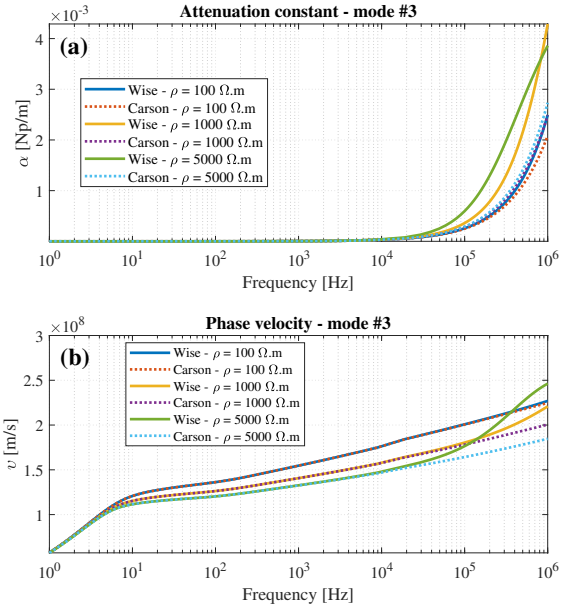

Fig. 4. Attenuation constant (a) and phase velocity (b) for mode #3 (ground mode), comparing Carson and Wise's admittance formulas, with constant soil parameters and different soil resistivities.

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D. Influence of soil model

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IV. Pipeline Induced Voltages

A. Frequency-domain responses

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B. Transient responses

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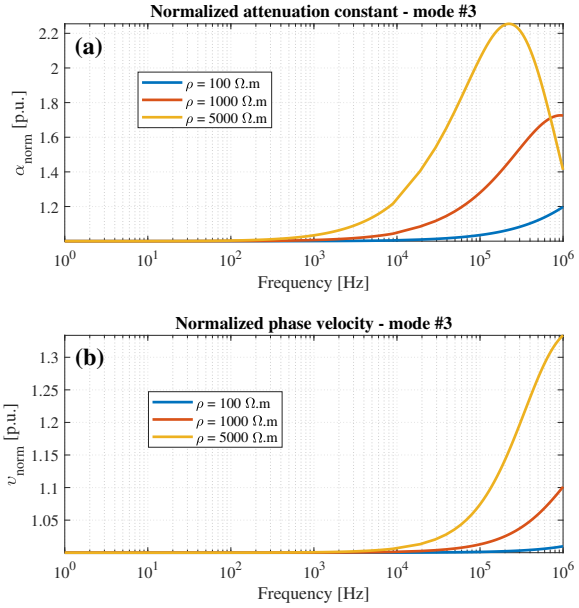

Fig. 5. Normalized attenuation constant (a) and phase velocity (b) for mode #3 (ground mode), comparing Carson and Wise's admittance formulas, with constant soil parameters and different soil resistivities.

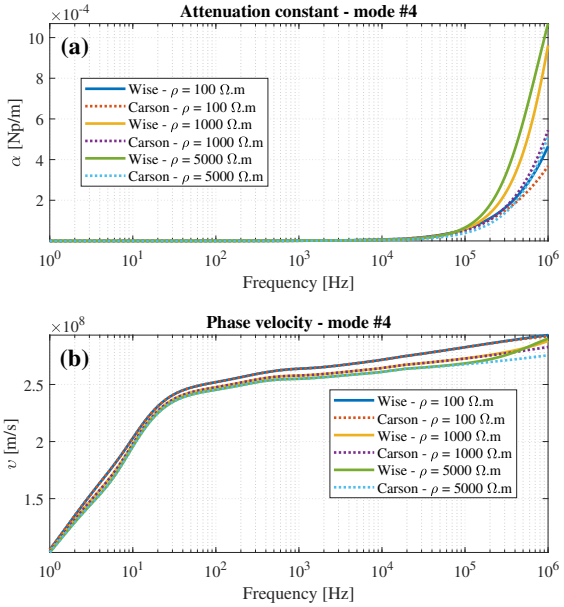

Fig. 6. Attenuation constant (a) and phase velocity (b) for mode #4 (pipeline mode), comparing Carson and Wise's admittance formulas, with constant soil parameters and different soil resistivities.

V. Conclusions

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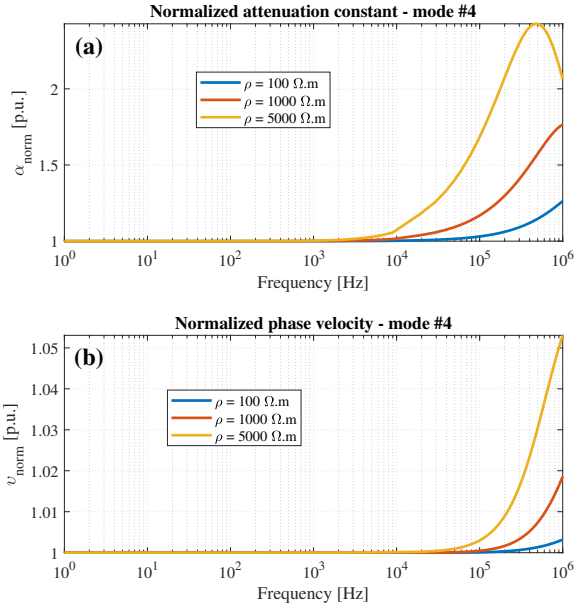

Fig. 7. Normalized attenuation constant (a) and phase velocity (b) for mode #4 (pipeline mode), comparing Carson and Wise's admittance formulas, with constant soil parameters and different soil resistivities.

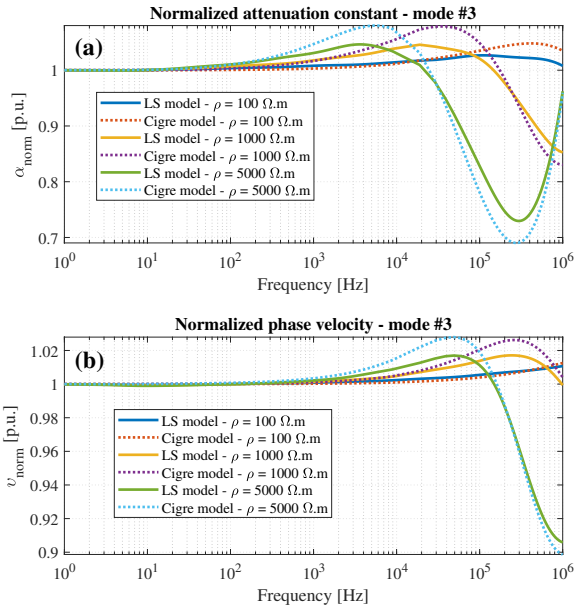

Fig. 8. Normalized attenuation constant (a) and phase velocity (b) for mode #3 (ground mode), comparing LS and Cigre frequency-dependence models, using Wise's formula and different soil resistivities.

ACKNOWLEDGMENTS

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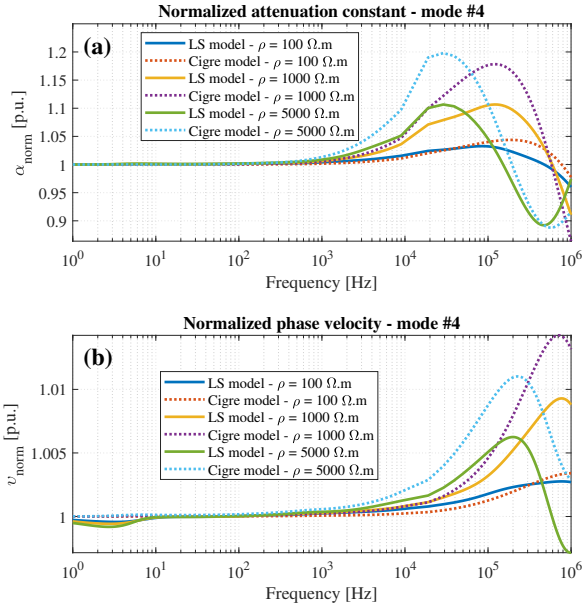

Fig. 9. Normalized attenuation constant (a) and phase velocity (b) for mode #4 (pipeline mode), comparing LS and Cigre frequency-dependence models, using Wise's formula and different soil resistivities.

REFERENCES

[1] *Bibliography goes here.*