

WAVE-DIGITAL POLARITY AND CURRENT INVERTERS AND THEIR APPLICATION TO VIRTUAL ANALOG AUDIO PROCESSING

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Objectives

- Introduction of adaptors for mixing WDF subnetworks using different polarity and sign conventions
- Extension of the definition of pseudopower to the active sign convention
- Verification in a nontrivial scenario

Polarity and Current Inverters

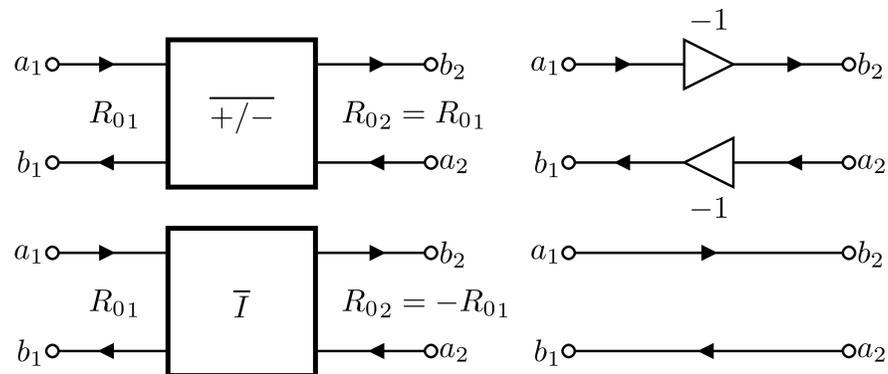


Figure 1: WDF polarity and current inverters and their signal flow diagrams.

Both are *pseudopassive*, *pseudolossless* and *nonenergetic*.

New Pseudopower Definitions

Instantaneous pseudopower absorbed by an n -port element at time instant t :

$$\hat{p}(t) = \sum_{\nu=1}^n k_{\nu} [a_{\nu}^2(t) - b_{\nu}^2(t)] G_{0_{\nu}}$$

Steady-state pseudopower absorbed by an n -port element:

$$\hat{P} = \sum_{\nu=1}^n k_{\nu} (|A_{\nu}|^2 - |B_{\nu}|^2) G_{0_{\nu}}$$

$k_{\nu} = 1$ if the passive sign convention is used at port ν , $k_{\nu} = -1$ otherwise.

References

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5. G. De Sanctis and A. Sarti, "Virtual analog modeling in the wave-digital domain," *Trans. Audio, Speech and Lang. Process.*, vol. 18, pp. 715–727, May 2010.
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Case Study: Triode Tube Amplifier Model

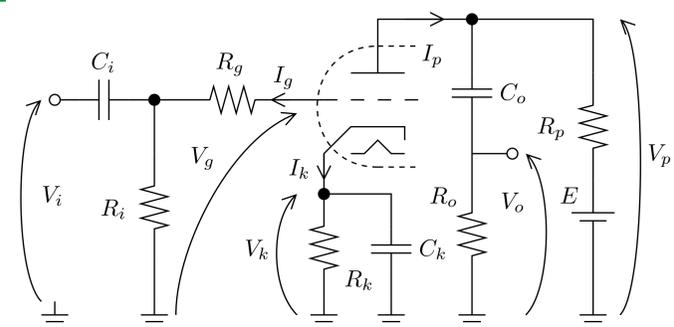


Figure 2: Triode amplifier stage.

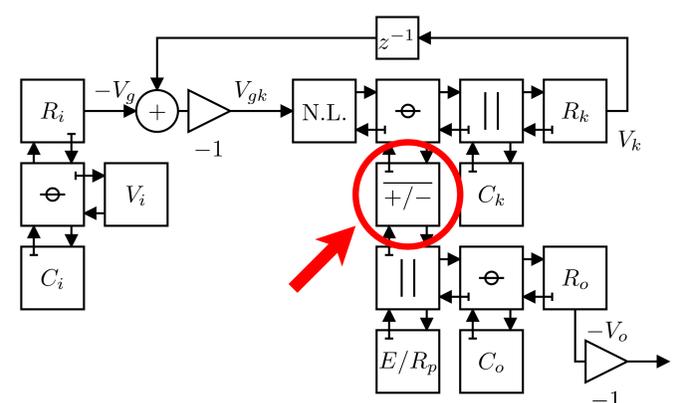


Figure 3: WDF-based implementation with polarity inverter.

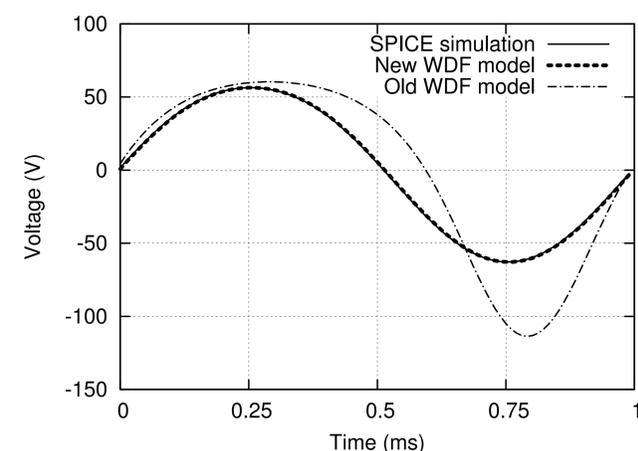


Figure 4: Output comparison between WDF simulators with (new model) and without (old model [6]) polarity inverter.