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Industrial Solutions and Services

IBIS Models with Reactive Loads

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Overview

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- **Motivation**
- **Arpad's conclusion to the „Accuracy of IBIS models with reactive loads" (IBIS Summit Santa Clara 2006)**
- **What to do, if the load is reactive?**
  - **Transistor Model**
  - **IBIS Model**
- **Approach by superposition of models / WF with X-loads**
- **Summary**

Requirements from automotive industry

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- **Request for using IBIS Models**
  - **IEEE-Standard**
  - **SI / EMC – tools**
- **Automotive specific environment**
  - **+ low frequencies**
  - **+ moderate voltage slopes**
  - **- high voltage swing and high currents**
  - **- reactive loads (coils, motors)**
  - **- cable as transmission line**
- **Focus on EM radiation and susceptability**

IBIS-model vs. HSPICE and Measurement in the ➔ Time domain

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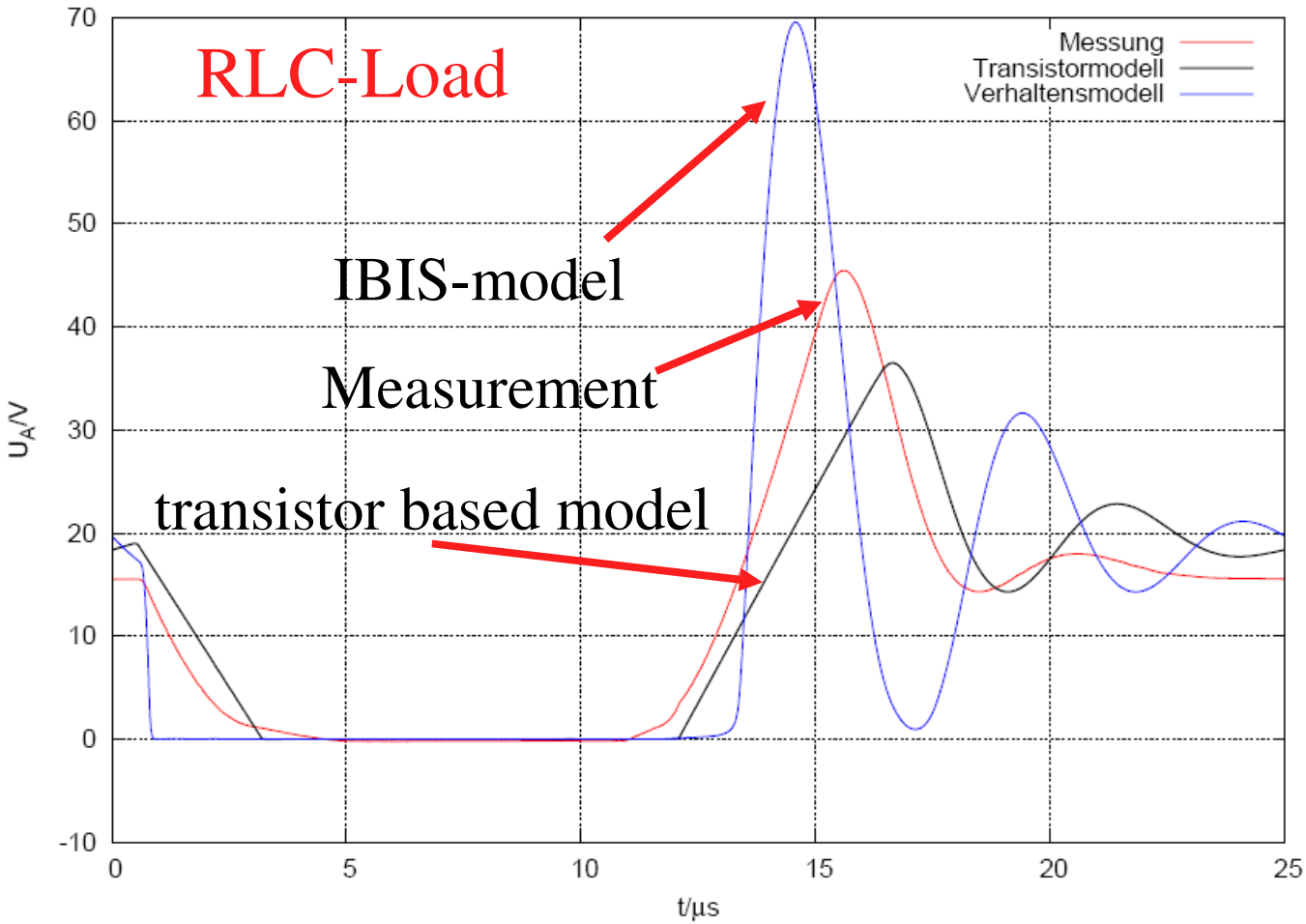

from Dr.-Ing. U. Neibig – R. Bosch GmbH, @ EMV2006

➔ Frequency domain

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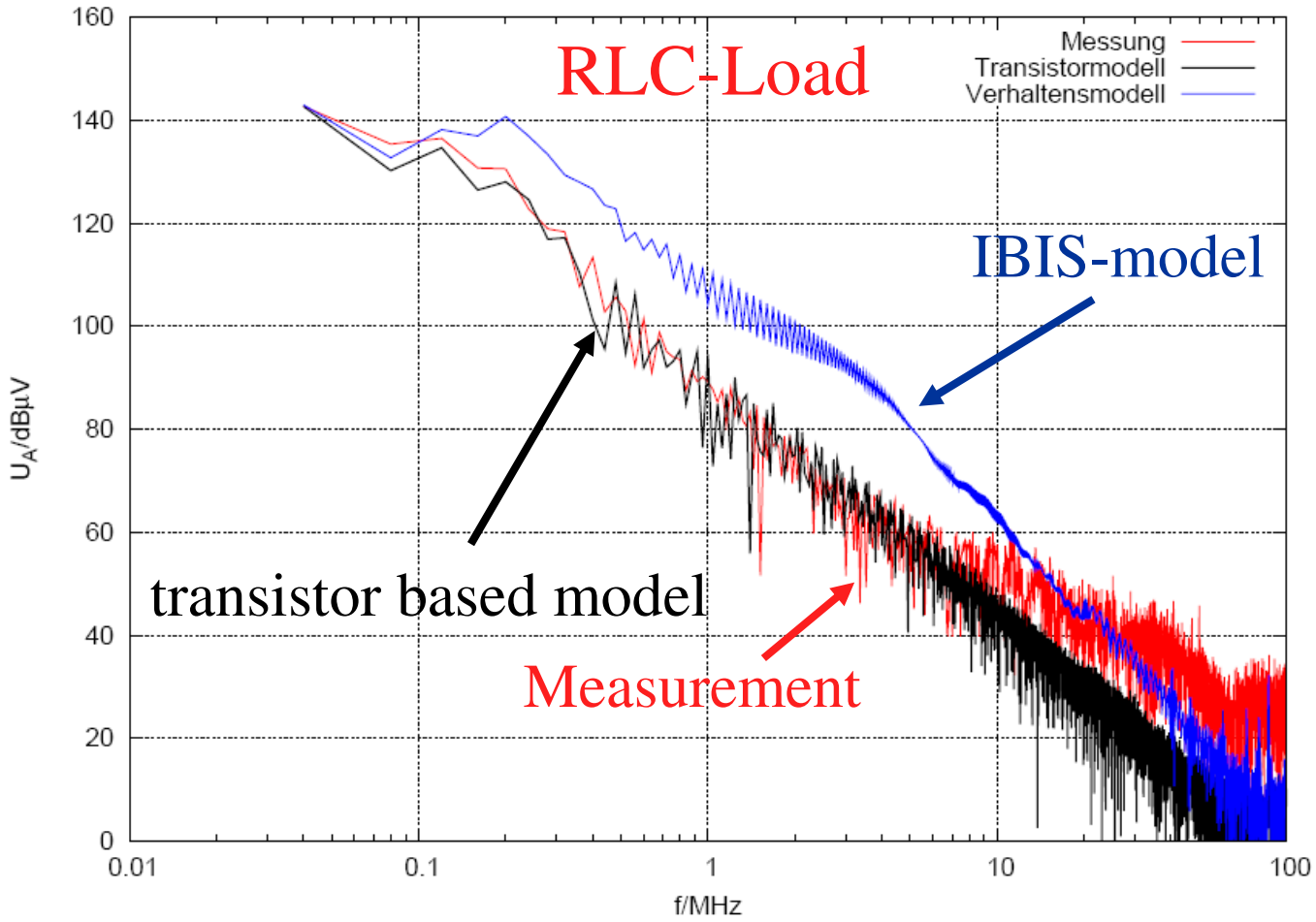

from Dr.-Ing. U. Neibig – R. Bosch GmbH, @ EMV2006

IBIS Models inadequate for Reactive Loads

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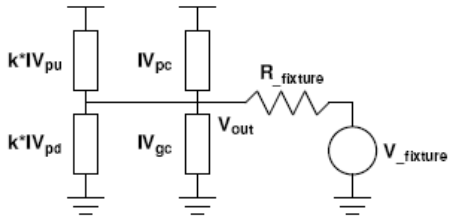
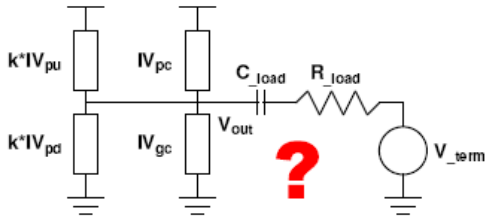
Arpad Muranyi – DesignCon. Santa Clara 2006

Problem statement





$$0 = k_{pu}(t) \cdot IV_{pu}(V_{wfm1}(t)) + IV_{pc}(V_{wfm1}(t)) - k_{pd}(t) \cdot IV_{pd}(V_{wfm1}(t)) - IV_{gc}(V_{wfm1}(t)) - I_{out}(V_{wfm1}(t))$$

$$0 = k_{pu}(t) \cdot IV_{pu}(V_{wfm2}(t)) + IV_{pc}(V_{wfm2}(t)) - k_{pd}(t) \cdot IV_{pd}(V_{wfm2}(t)) - IV_{gc}(V_{wfm2}(t)) - I_{out}(V_{wfm2}(t))$$

where

$$I_{out} = \frac{V_{out} - V_{fixture}}{R_{fixture}}$$

dV/dt and/or dI/dt are missing from this equation

The current of the capacitor is I = C*dV/dt

The voltage of an inductor is V = L*dI/dt

$$Iout \neq \frac{Vout - Vfixture}{Rfixture}$$

Aproach for Superposition of Reactive WF

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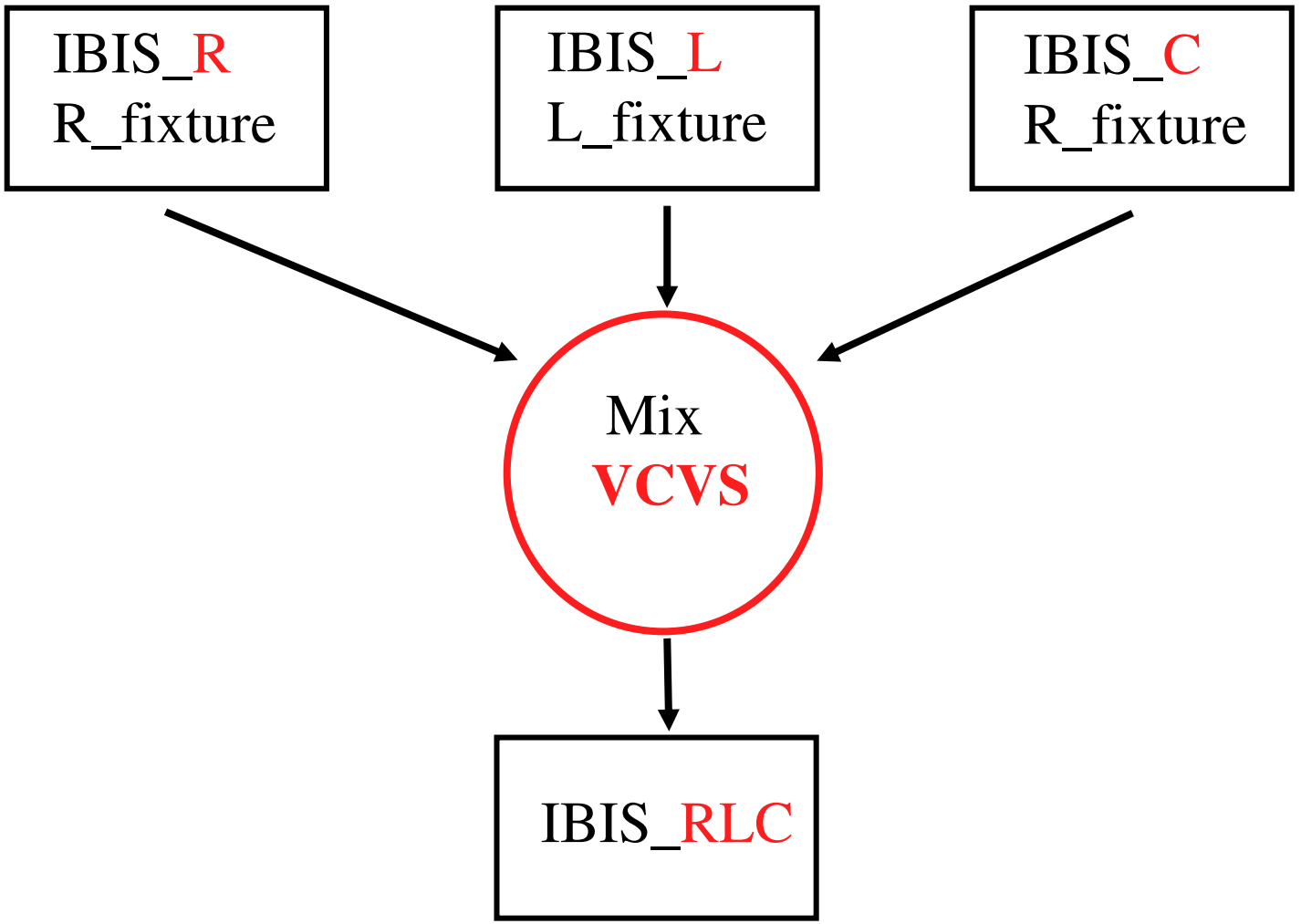

WF with X-load vs. Transistor based model

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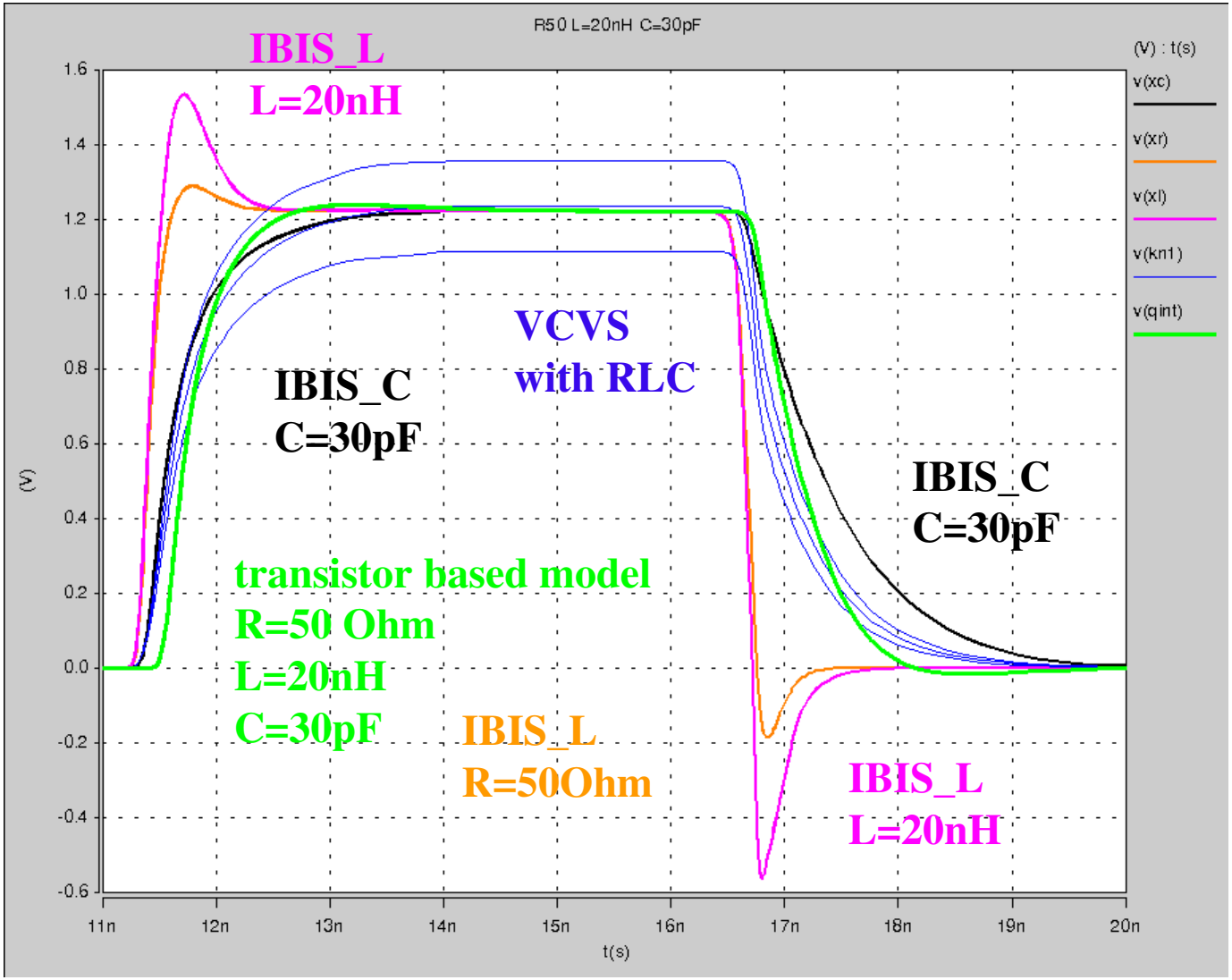

WF with X-load vs. Transistor based model (zoom)

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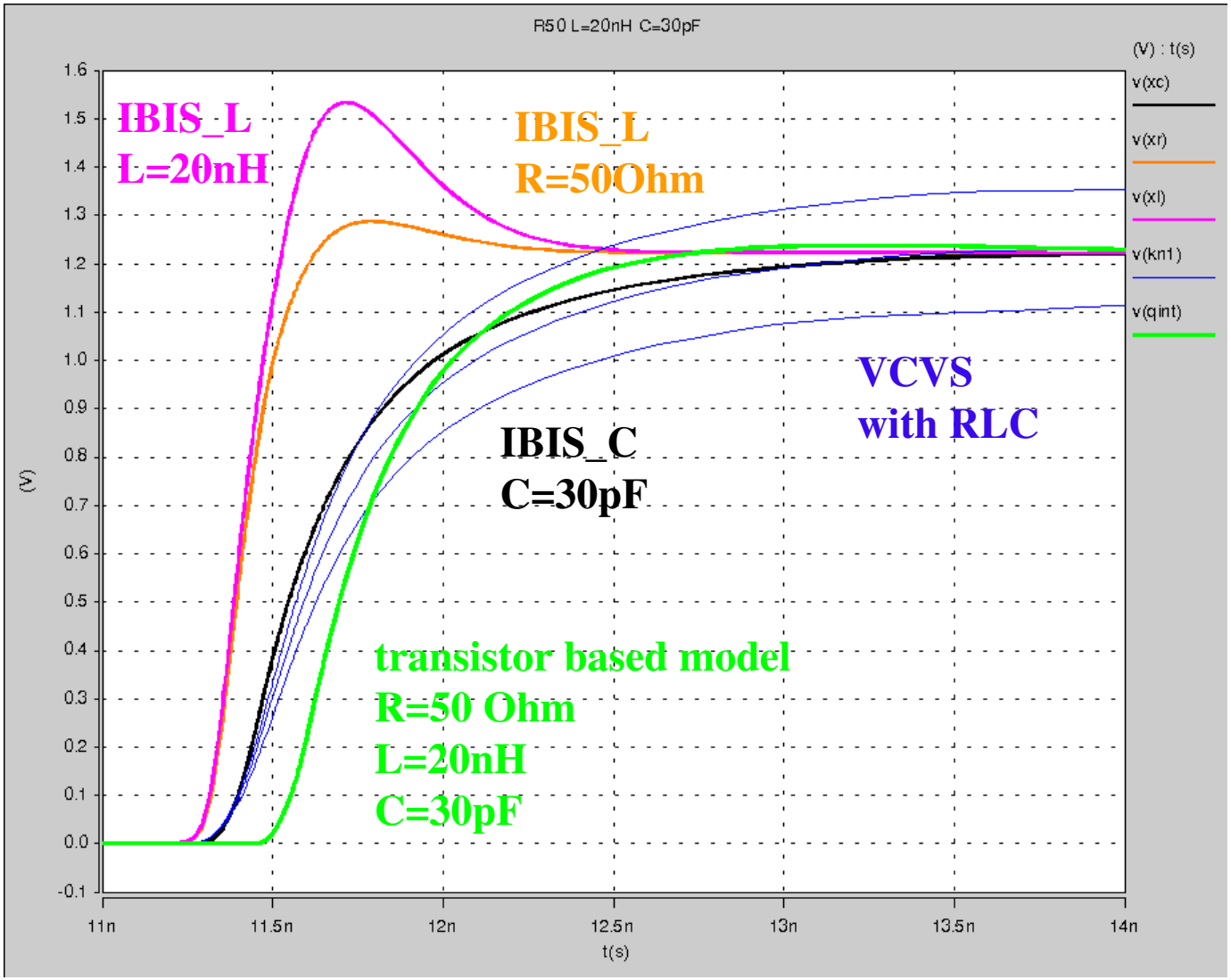

WF with X-load vs. Transistor based model (zoom)

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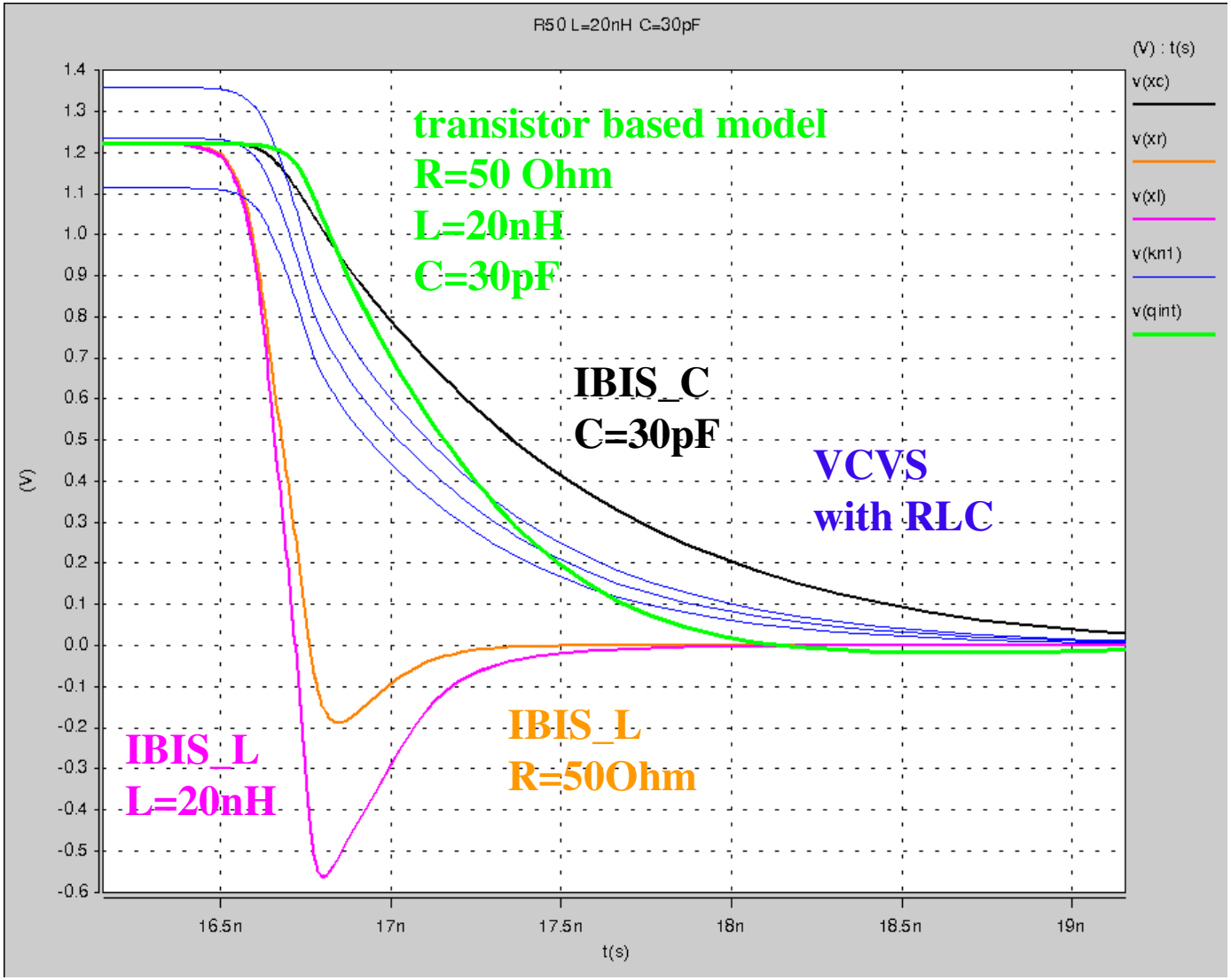

Summary

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- IF the IBIS models with the same reactive load, as the application
  - ➔ fitting results

    but

    - not practicable ➔ huge # of models/waveforms
    - slightly different X-load ➔ unpredictable results
- By superposition of different models with X-loads
  - NO simple, unique way to the solution
  - more investigation has to be done
- Reactive Loads can be actually described by:
  - Transistor models
  - VHDL-AMS

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Questions