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A simplified model of flexible power point tracking algorithms in double-stage photovoltaic systems

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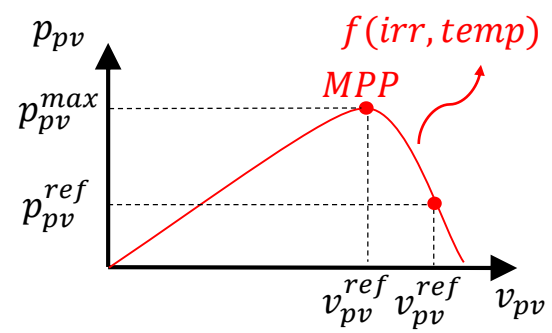
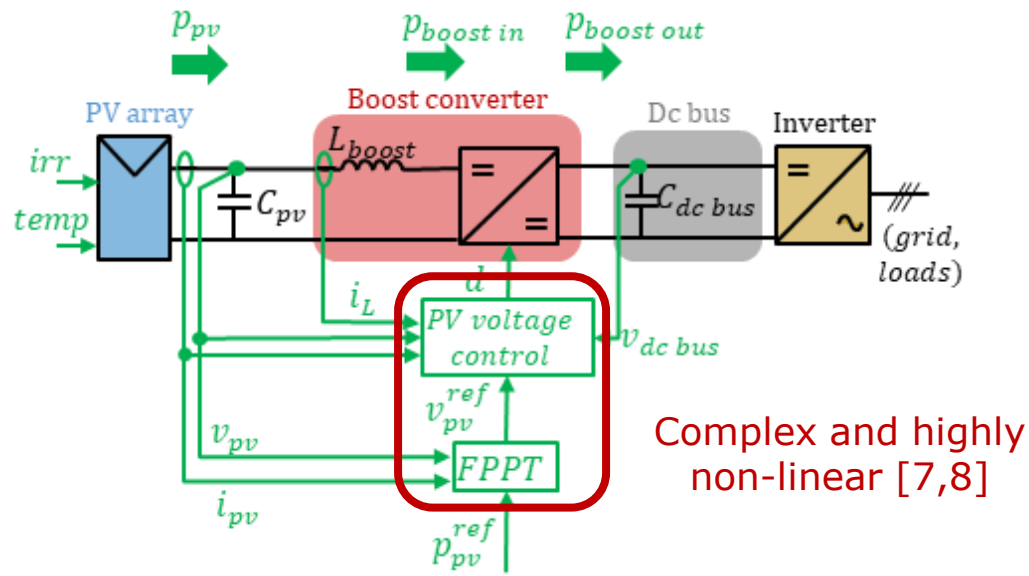
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1. Introduction

- Electrical grids are experiencing an increased penetration of PV systems
- Traditionally, PVs are operated in grid-feeding mode (with MPPT algorithms)
- However, new uses are emerging:
 - Grid-feeding PVs + power limiting control [1,2]
 - Grid-forming PVs [3,4]
- Both **require substituting MPPTs by FPPTs** [5,6]

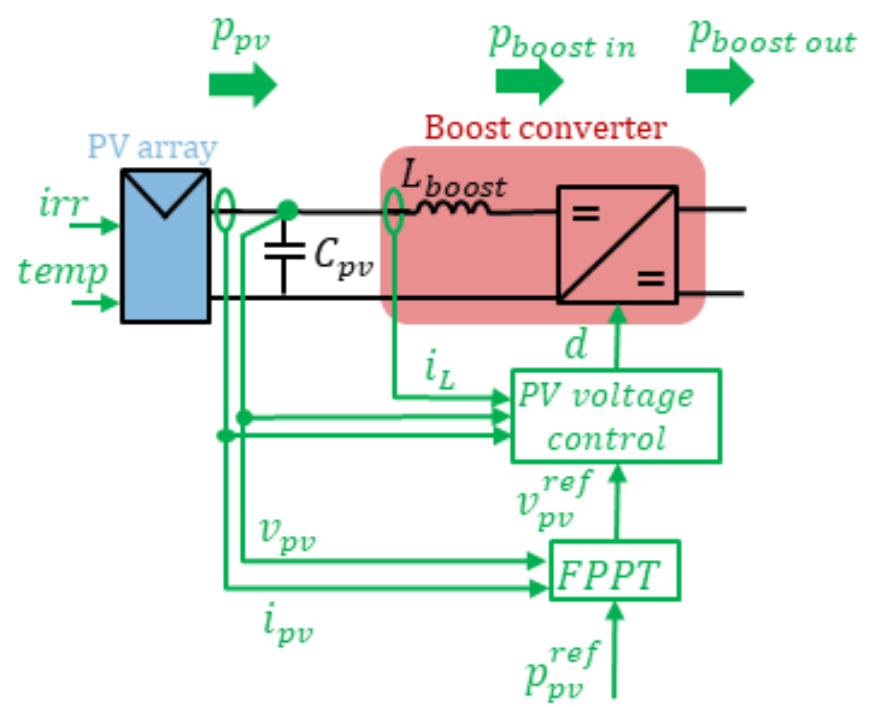


1. Introduction

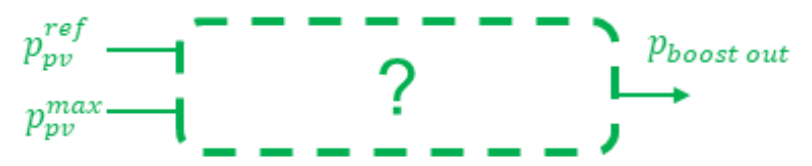
- We propose a **simplified model for FPPT controlled PV systems**
- Model's merits:
 - Can be translated into differential equations, that can be easily linearized
 - Easy tuning
 - Reduced simulation times

2. Proposed model

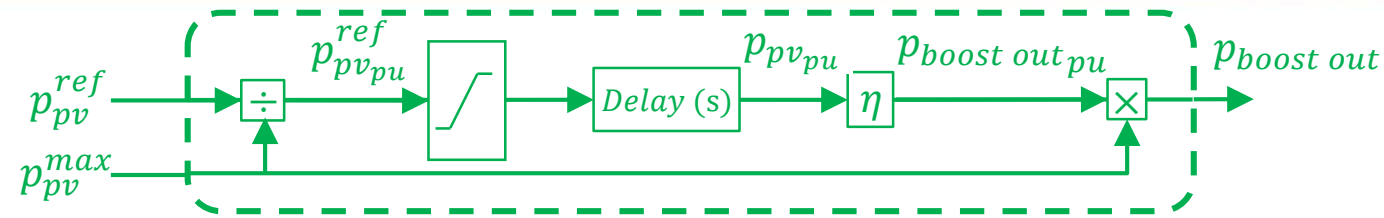
Detailed model



Proposed model

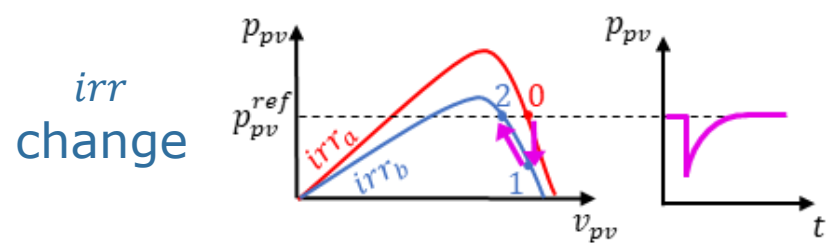
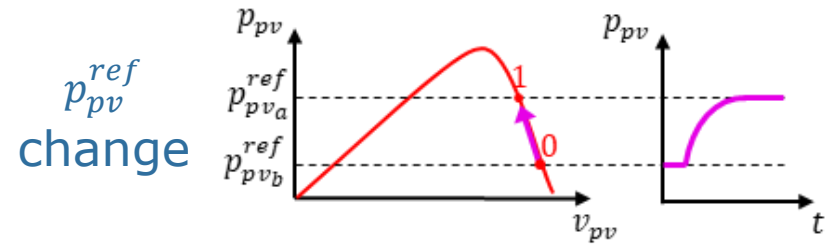


2. Proposed model

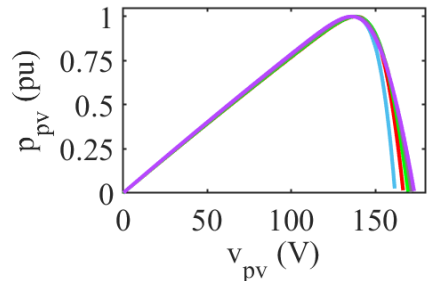
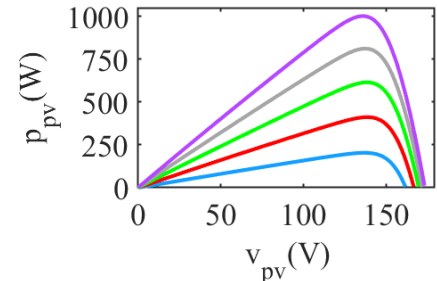
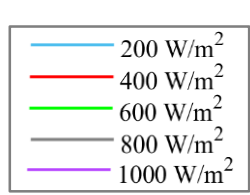


• Simplifying hypotheses:

1. FPPT dynamics are dominant

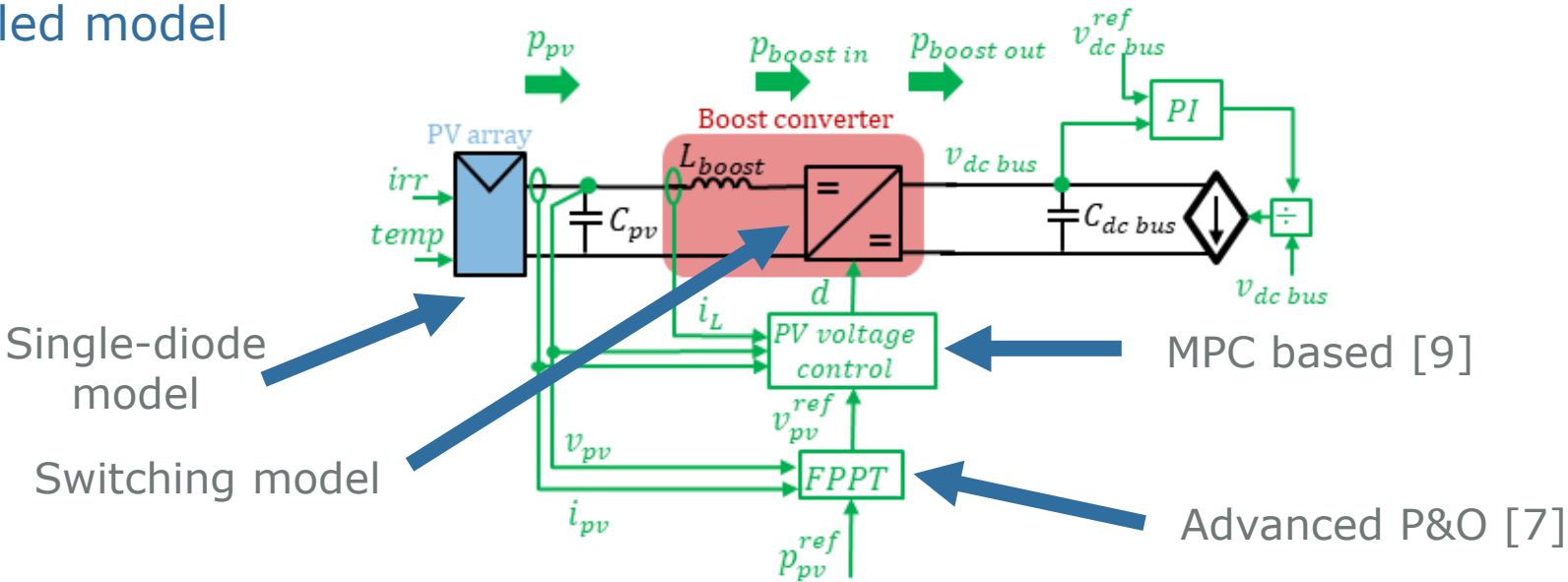


2. $\frac{p_{pv}^{irr\ b}(v_{pv}^0)}{p_{pv\ max}^{irr\ b}} = \frac{p_{pv}^{irr\ a}(v_{pv}^0)}{p_{pv\ max}^{irr\ a}} \leftrightarrow p_{pv\ pu}^{irr\ b}(v_{pv}^0) = p_{pv\ pu}^{irr\ a}(v_{pv}^0)$ and constant temperature

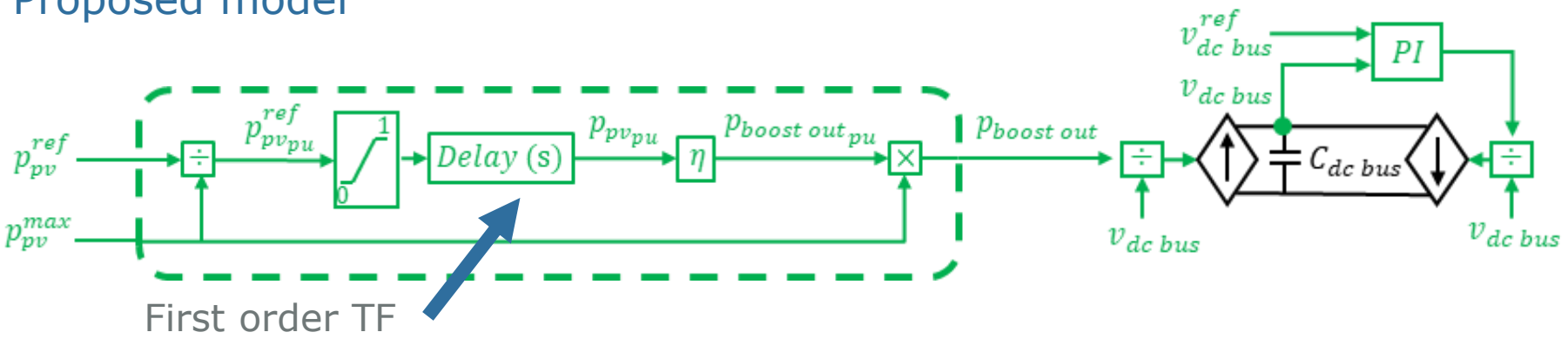


4. Model evaluation

Detailed model



Proposed model

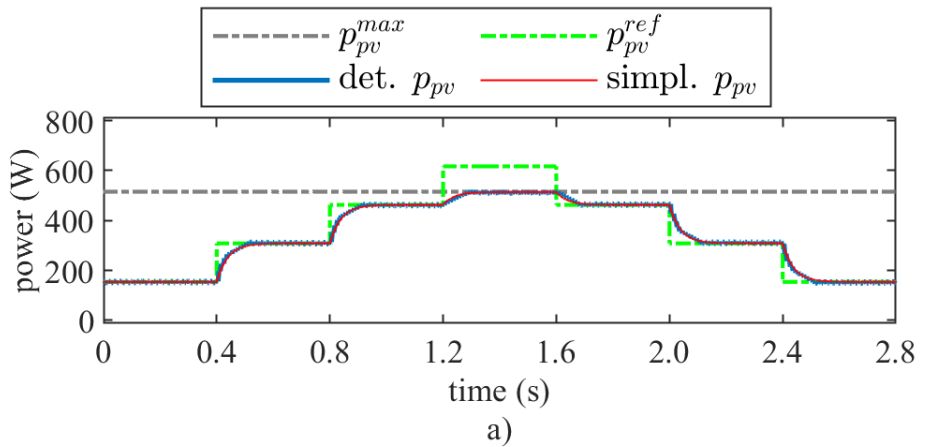


First order TF

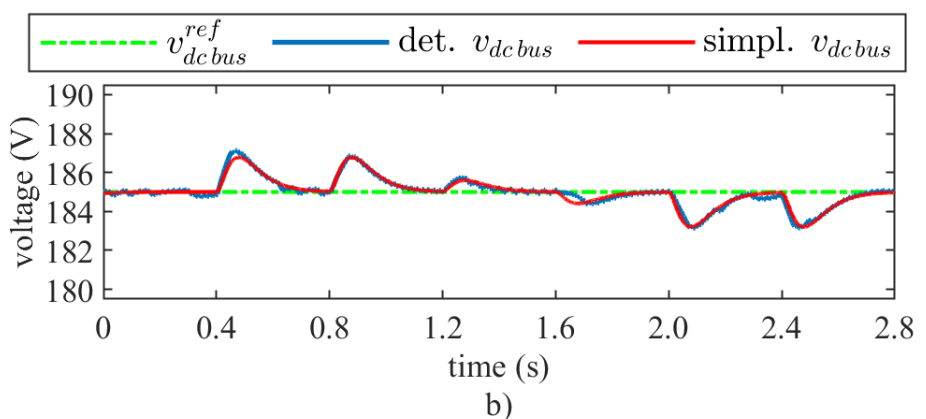
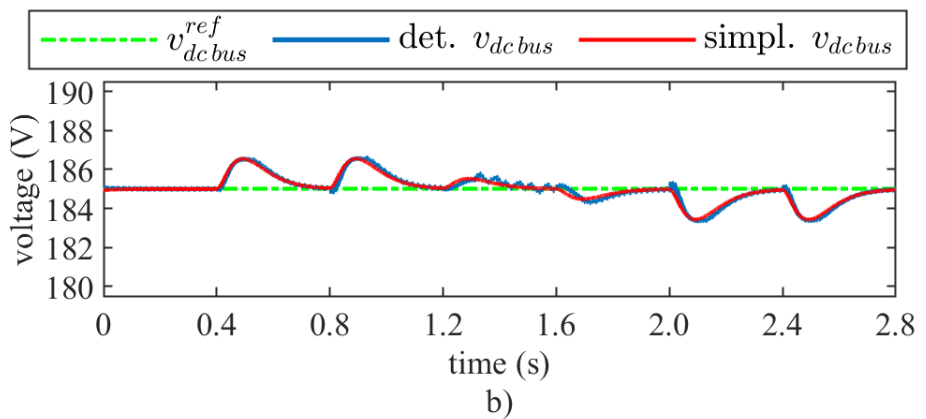
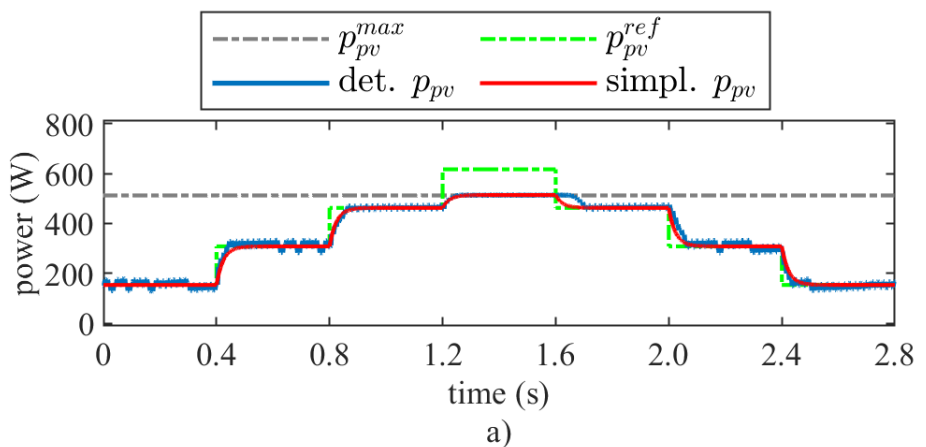
4. Model evaluation

- p_{pv}^{ref} steps

Left-side operation



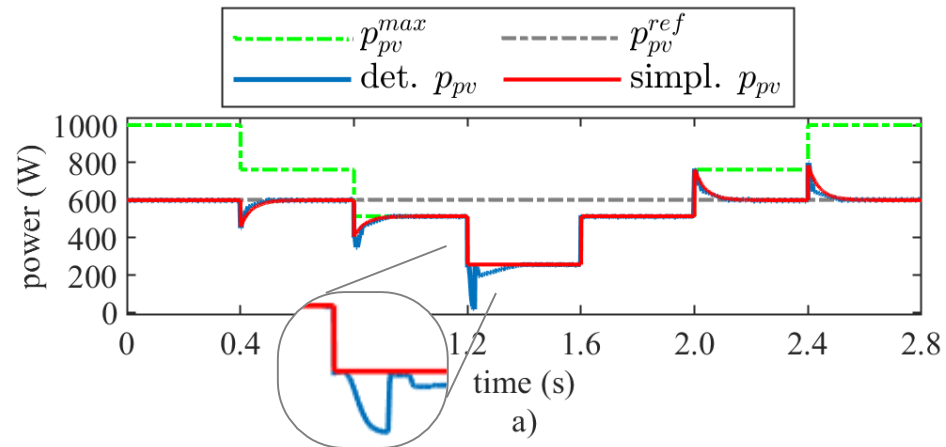
Right-side operation



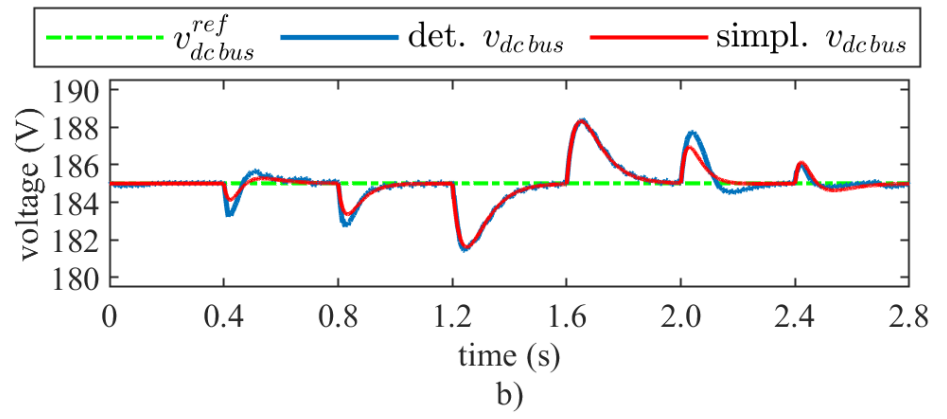
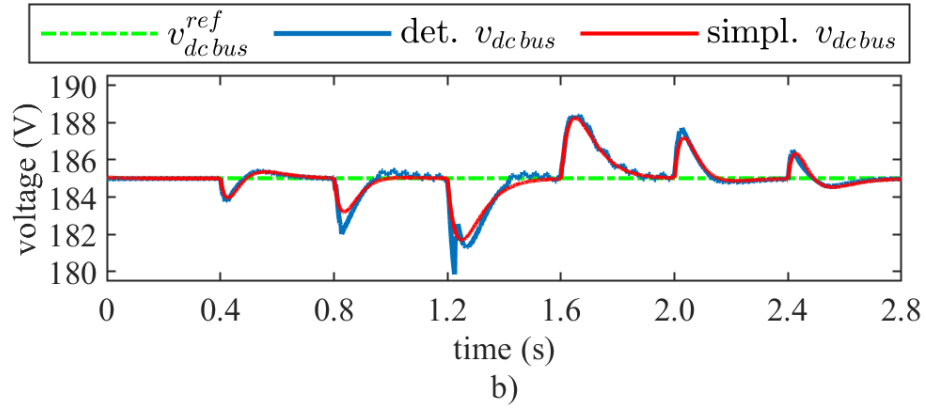
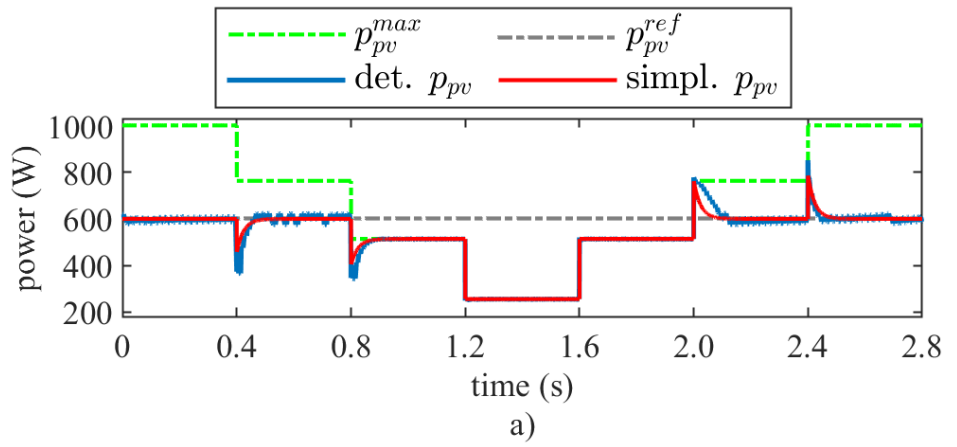
4. Model evaluation

- irr steps**

Left-side operation



Right-side operation



4. Conclusions and perspectives

- **Conclusions:**

- The proposed model captures **the main dynamics of a FPPT-controlled PV system**
(If the FPPT delay can be approximated by a transfer function)
- The main merit of the model is that **enables the linearization of highly non-linear systems**
- In addition, it benefits from an **easy tuning and short simulation times**

- **Perspectives:**

- Introduce the inverter's dc side dynamics in ac stability analyses
- Obtain the equivalent simplified model of other FPPTs

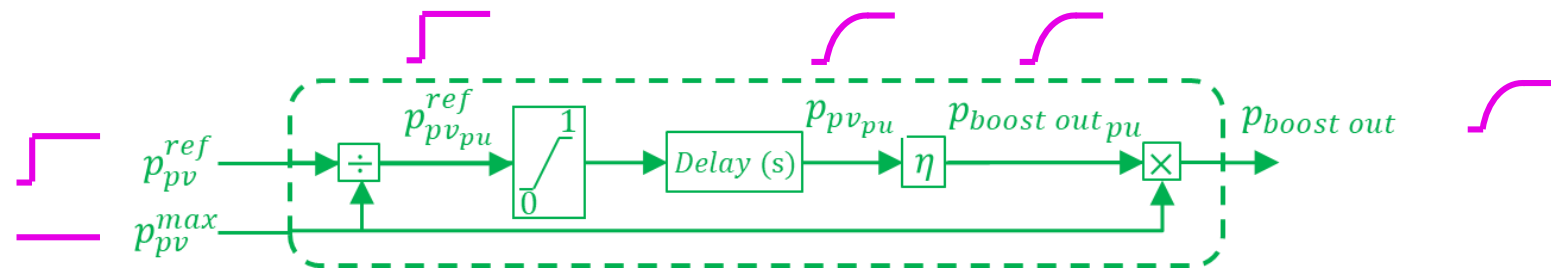
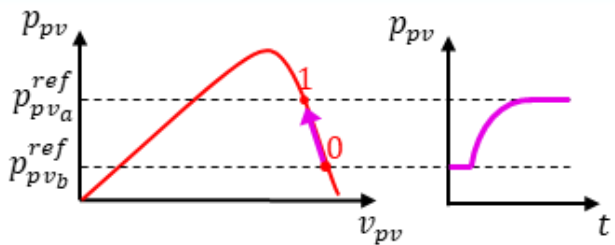
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Thank you for your attention !

Annex: Proposed model

p_{pv}^{ref}
change



i_{rr}
change

