Compensating a Power Amplifier using Iterative Learning Control : from Design to Realisation

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Thank You Note

Abstract

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Chapter 1

Introduction

1.1 Why Digital Predistortion?

Power amplifiers are used in almost all wireless communication devices. They amplify the communication signal such that a good signal to noise ratio is obtained. They also are an important power consuming block in a communication chain. A power amplifier is often operated in a nonlinear operation mode to improve its efficiency. This nonlinear behavior should be compensated in a later step to reach the strict telecommunication requirements. A Digital Pre-Distortion (DPD) is a common technique to linearize the input-output behavior of a power amplifier. With DPD the input signal of the amplifier is modified such that the desired (i.e. linear) behavior is obtained.

1.2 Current Techniques of DPD

1.2.1 Direct and Indirect Learning

1.2.2 Nonlinear Models

1.3 The Best Linear Approximation

1.3.1 What is the BLA?

1.3.2 How to measure it?

1.3.3 Out of Band BLA and the Tickler Tone

1.4 Iterative Learning Control

1.4.1 The Algorithm

1.4.2 Properties

Chapter 2

Using the BLA in ILC for DPD

2.1 Introduction

2.2 The Blocky Tought Experiment

A nonlinear dynamic system can alternatively be represented by the combination of a linear transfer function G_{BLA} and a nonlinear function F.

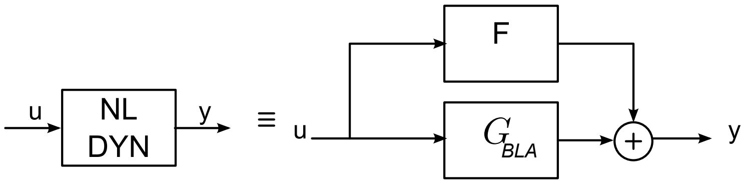

Figure 2.1: Alternative representations of a nonlinear system.

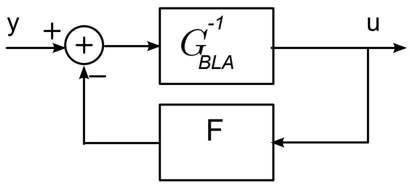

Figure 2.2: Switching the input and output, creating the inverse of the nonlinear system.

2.3 Why can it work?

1.

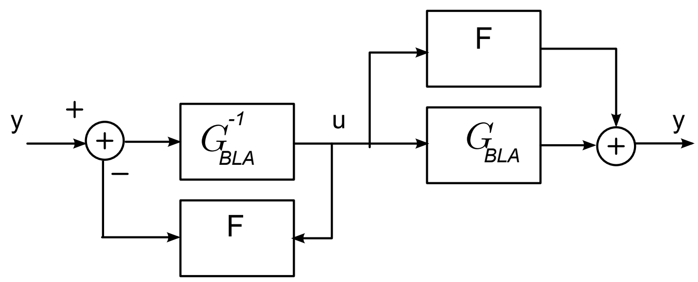

Figure 2.3: Connecting the inverse and the original system together.

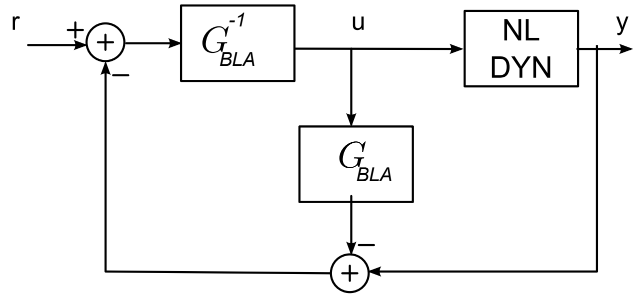

Figure 2.4: Getting creative with the blocks.

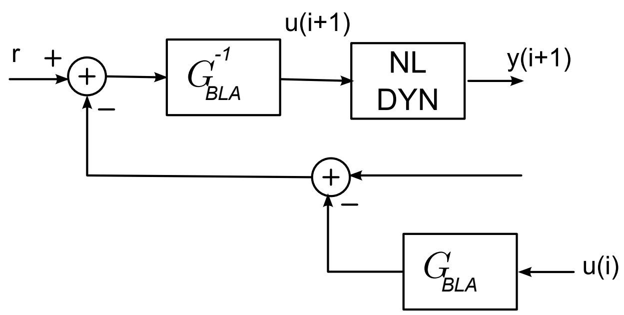

Figure 2.5: Cut the loop!

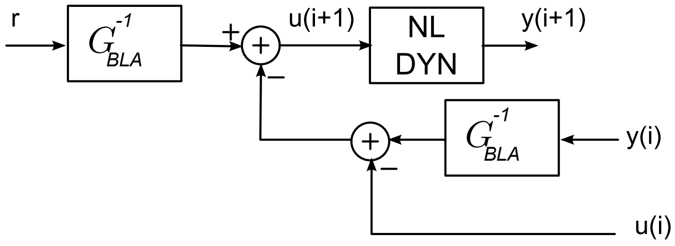

Figure 2.6: Reorganise the blocks one last time.

2.4 Creation of a standalone DPD

2.5 Estimating the Preinverse

Chapter 3

Simulation Results

3.1 ILC with BLA

3.1.1 Test on Different Systems

3.1.2 Influence of Noise

3.1.3 Study of Convergence

3.1.4 Compensate to Static Gain or BLA?

3.2 Standalone DPD

Chapter 4

Application on a Audio Valve Amplifier

4.1 The Synchronisation Challenge

4.2 Measure the BLA

4.3 Apply ILC

4.4 Estimate DPD

4.5 Results

Chapter 5

Conclusion

Bibliography

[1] J. Schoukens, R. Pintelon, Y. Rolain , *Mastering System Identification in 100 Exercises.* IEEE Press (2012), 183-238.