To understand, simulate and control physical systems, good mathematical models are required. System identification is a powerful tool that distills mathematical models from measurements. To this end, one has to:

- perform experiments to observe the system in a meaningful way,
- suppress unwanted effects and extract the features of interest, and
- fit a model to the measurements.

Unfortunately, the effective use of system identification hinges strongly on the skill of the user. This doctorate focuses on easy-to-use system identification tools. These should allow both beginners to obtain good models, and seasoned practitioners to obtain better models with more ease.

First, the design of a robust all-purpose experiment is investigated. In contrast to optimal designs, only a few assumptions about the system, i.e. the minimal damping and the frequency bands of interest, are made. Therefore, such a constructed multisine signal can measure different systems efficiently.

The second part of this thesis describes non-parametric estimators for the frequency response function (FRF) that estimate and suppress leakage and noise effects. Extensions of the Local Polynomial and Local Rational Method are investigated. These method approximate the input-output measurements in local frequency domain windows by either polynomial or rational models.

Such local models can be used to great effect e.g. to describe the flexible dynamics of mechanical structures. These local models have been used to obtain a more detailed view of the many resonance peaks of an active vibration isolation system than typical FRFs provide. Unlike high-order models, they don't incur a laborious model-order selection and are hence easy to apply in an automated fashion. In doing so, the measurement time and modeling effort can be reduced significantly.

The final part of the thesis considers the use of FRF smoothers to obtain better initial values to fit parametric models to the measurement data. In particular for low signal-to-noise ratios, local modeling or regularization provide considerable improvements by reducing the influence of noise in the estimation process. This allows users to obtain significantly better models, even from poor measurements.

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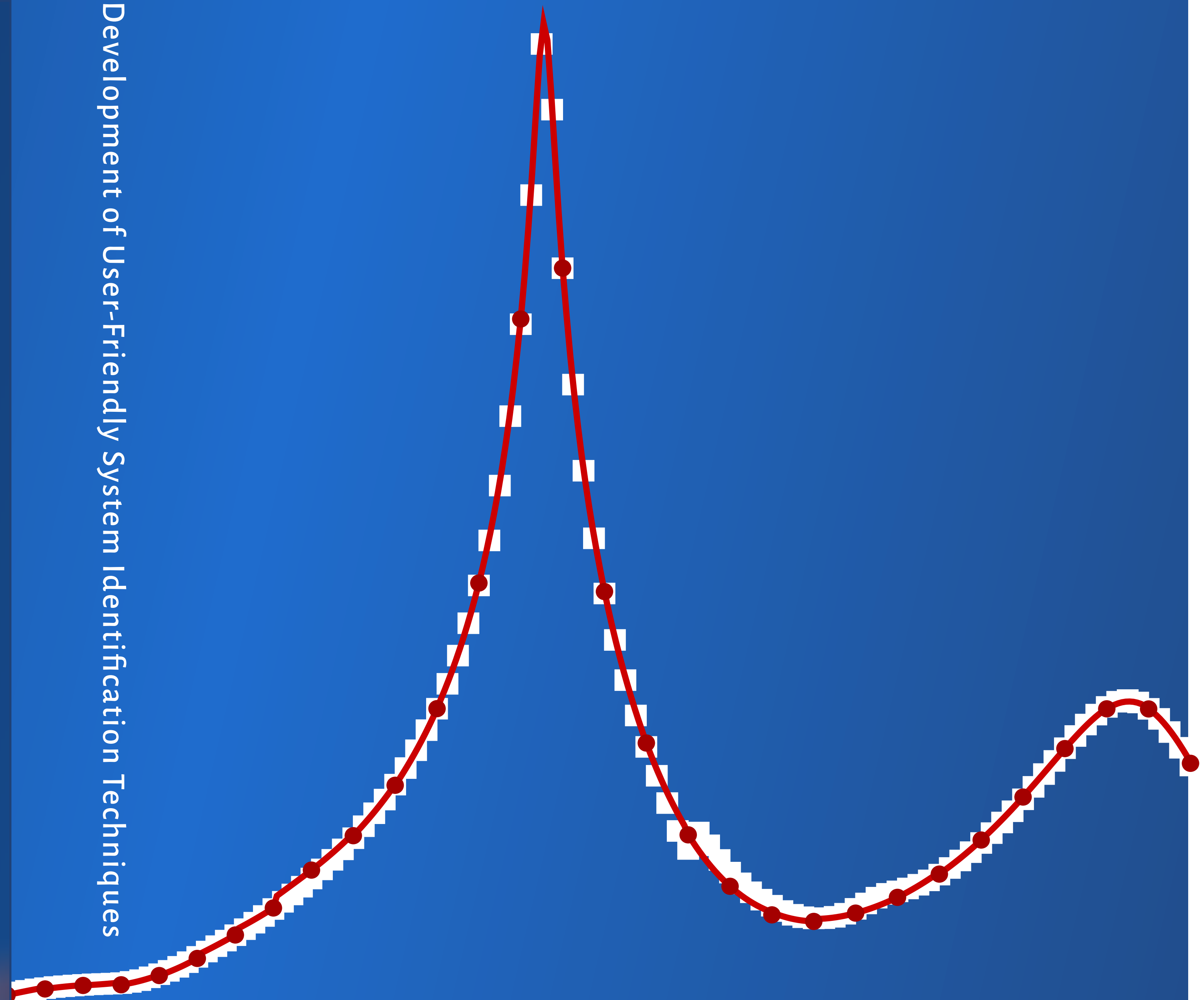
Vrije Universiteit Brussel
Faculty of Engineering
Department ELEC

Development of User-Friendly System Identification Techniques

Egon Geerardyn



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