Identifying a C-arc medical X-ray system : a 2D-LRM approach

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1 Introduction

The calibration of a C-arc based medical X-ray systems, as depicted in Fig. 1, can either be approached from a motion control point of view or using model-based approaches, [1]. The dynamical behavior of the system is depending on the operating conditions; the system is linear parameter varying (LPV). This provides a systematic framework for controller design. The aim of this work is to develop a nonparametric identification approach to obtain accurate FRFs of the X-ray system for a set of "frozen" workpoints. These accurate FRFs can be the basis for both controller design and (local) LPV modeling, [2], [3], [4].

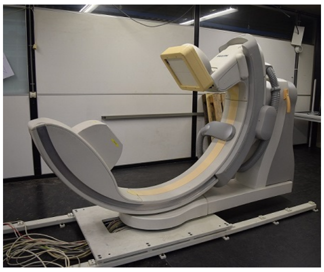
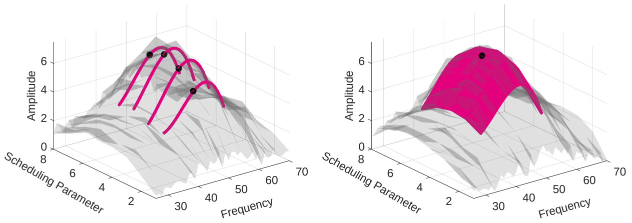


Figure 1: Philips Allura Centron interventional X-ray System.

2 Local Parametric Methods for LPV systems

State-of-the-art identification methods exploit the smoothness of a FRF over the frequencies, [2]. Here, we propose a nD-LRM to also exploit smoothness over the scheduling parameters, [5]. In particular, for traditional local parametric methods, a rational function is fitted on a local frequency window for each LTI experiment, as indicated in Fig. 2a. The proposed nD-LRM approach identifies the systems' dynamics on a local surface, as indicated in Fig. 2b.

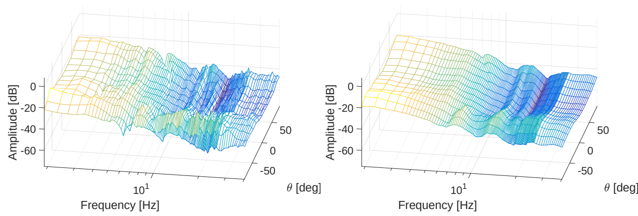


(a) Local rational method (b) 2D-local rational method

Figure 2: Proposed approach, compared to traditional LTI methods.

3 Measurement Results

The medical X-ray system in Fig. 1 has several degrees of freedom, which each cause varying dynamics. Here, a single degree of freedom has been identified at 13 individual poses of the system. The data obtained from the same identification experiments are processed using traditional local rational methods and using the proposed 2D-LRM approach, for which the resulting Bode diagrams are shown in Fig. 3.



(a) Traditional LRM (b) Proposed 2D-LRM

Figure 3: Comparison of traditional method with the proposed method based on measurements.

4 Conclusions

For the medical X-ray system, the proposed nD-LRM approach shows significant potential in terms of estimation quality and measurement times. With identical measurement times, smoother Bode diagrams with significantly reduced variances are obtained. These improved identified FRFs are directly usable for state estimations or controller design, [4].

References

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