System Analysis Laboratory

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Professor

In AY2015, a member, Dr.Mori, of the System Analysis Laboratory mainly, continues to investigate the theory of stabilizing theory. He also investigated the visualization system for two-stage compensator designs with his graduated students.

We have considered the models in which some plants admit and in which some plants do not admit coprime factorization. In the case where the plants admits only one-side coprime factorization, it is known that the plant with additional zeros admits both side coprime factorizations. However we have shown that in the case where the plant do not admit coprime factorization, there exists a case where the plant with any finite additional zeros cannot admit coprime factorization. We will also consider the parallel plants, in which one of them is plant to be stabilized. Any stabilizable plants has some parallel plants that admit both side coprime factorizations. We will show that this fact can applied to stabilizable plants only, so that unstabilizable plants is not able to construct such parallel plants.

We have also considered the number of parameters for the parametrization of stabilizing controllers for RH_∞ systems with size two times two Fortunately, any plant of this model can admit doubly coprime factorization. Thus we can use the Youla parameterization to parametrize the stabilizing contollers . However, Youla parameterization does not guarantee that the number of parameters is minimal. We showed that the minimal number of parameters is four. As a result, we have shown that the Youla parametrization naturally gives the parameterization of stabilizing controllers with minimal numbers.

We further considered the two-stage compensator designs for single-input and single-output (SISO) plants and multi-input and multi-output (MIMO) plants in the framework of the factorization approach. As an investigation of the role of the

two-stage compensator designs, we have implemented two visualization systems of the parametrization of stabilizing controllers based on the two-stage compensator design. One is animation system. The other is three-dimensional (3D) graph system. These systems display input-output relationship and norms of signals. Based on the two-stage compensator designs, we have implemented the system in which the outputs are shown by the animation system and the 3D graph system. On the other hand, the input signals can be visualized two-dimensional (2D) graphs. Further, the norms of signals can also be visualized in 2D graphs. As a model of the factorization approach, we have employed the discrete-time LTI systems.

As previously, a member, Dr. Mori, held public lectures for building a personal computer in University of Aizu. The public lectures held three times.

Refereed academic journal

[k-mori-104-009-01:2015] K. Mori. Coprime Factorizability and Stabilizability of Plants Extended by Zeros and Parallelled Some Plants. *Engineering Letters*, 24(1):93–97, 2016.

This paper is concerned with the factorization approach to control systems. It is known all models do not have both right- and left-coprime factorizations. In this paper, we consider the models in which some plants admit and in which some plants do not admit coprime factorization. In the case where the plants admits only one-side coprime factorization, it is known that the plant with additional zeros admits both side coprime factorizations. However we show that in the case where the plant do not admit coprime factorization, there exists a case where the plant with any finite additional zeros cannot admit coprime factorization. We will also consider the parallel plants, in which one of them is plant to be stabilized. Any stabilizable plants has some parallel plants that admit both side coprime factorizations. We will show that this fact can applied to stabilizable plants only, so that unstabilizable plants is not able to construct such parallel plants.

Refereed proceedings of an academic conference

[k-mori-104-009-02:2015] K. Mori. Examples of Parameterization of Stabilizing Controllers with One-Side Coprime Factorization. In *2015 International Conference on Electrical, Computer, Electronics and Communication Engineering*, pages 309–312, Miami, FL, 2015.

Examples of parameterization of stabilizing controllers that requires *only one* of right-/left-coprime factorizations are presented. One parameterization method requires one-side coprime factorization. The other requires no coprime factorization. The methods are based on the factorization approach, so that a number of models can be applied the method we use in this paper.

[k-mori-104-009-03:2015] K.Hashimoto and K. Mori. Visualization of Input-Output Relation of SISO/MIMO Systems Using Parametrization of Two-Stage Compensator Design. In *Proceedings of the IASTED International Conference Modelling, Identification and Control (MIC 2015)*, pages 172–179, Innsbruck, Austria, 2015.

In this paper, we consider the two-stage compensator de- signs for single-input

and single-output (SISO) plants and multi-input and multi-output (MIMO) plants in the framework of the factorization approach. Recently, one of the authors has given the parametrization of stabilizing controllers given by the two-stage compensator design. As an investigation of the role of the two-stage compensator designs, we implement two visualization systems of the parametrization of stabilizing controllers based on the two-stage compensator design. One is animation system. The other is three-dimensional (3D) graph system. These systems display input-output relationship and norms of signals. Based on the two-stage compensator designs, we have implemented the system in which the outputs are shown by the animation system and the 3D graph system. On the other hand, the input signals can be visualized two-dimensional (2D) graphs. Further, the norms of signals can also be visualized in 2D graphs. As a model of the factorization approach, we have employed the discrete-time LTI systems.

[k-mori-104-009-04:2015] K. Mori. Number of Necessary Parameters for Parametrization of Stabilizing Controllers for two times two RHinf Systems. In *The 17th International Conference on Electrical and Electronics Engineering (ICEEE 2015)*, pages 2541–2544, Paris, France, 2015.

In this paper, we consider the number of parameters for the parametrization of stabilizing controllers for RH_∞ systems with size two times two Fortunately, any plant of this model can admit doubly coprime factorization. Thus we can use the Youla parameterization to parametrize the stabilizing contollers . However, Youla parameterization does not guarantee that the number of parameters is minimal. This paper shows that the minimal number of parameters is four. As a result, we show that the Youla parametrization naturally gives the parameterization of stabilizing controllers with minimal numbers.

Academic society activities

[k-mori-104-009-05:2015] K. Mori, September 2016.

Executive Committee, Autum Conference.

Others

[k-mori-104-009-06:2015] K. MORI. IEEE, 2015.

Reviewer of IEEE Transaction of Automatic Control

Contributions related to regional education

[k-mori-104-009-07:2015] Dr. Mori held three public lectures for building computer in University of AIZU.