

## System Analysis Laboratory



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In FY2011, a member, Dr. Mori, of the System Analysis Laboratory mainly, investigates to develop the theory of the two-stage compensator designs.

The two-stage compensator designs for multi-input multi-output plants as well as single-input single-output plants are investigated.

First we consider the case where the models admits the coprime factorizability. Then, we have presented a more precise result than previous, which is like a part of Youla-parameterization. We then show other two-stage compensator designs, which are related with input-output relations. This is done by obtaining “full feedback” two-stage compensator design. We then show that even if we do not consider the coprime factorizability, the classical result of the two-stage compensator design holds. We also show other two-stage compensator designs, which are related with input-output relations. They give parametrizations of stabilizing controllers. Their parametrizations are, in general, partial. Even so, the number of parameters are reduced from the previous result.

The results of our research are based on the factorization approach only, so that they can be applied to numerous linear 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.

## Summary of Achievement

### Unrefereed Papers

- [k-mori-01:2012] K. Mori. Parameterisation of stabilising controllers with precompensators. *IET Control Theory and Applications*, 6(2):297–304, 2012.

Within the framework of the factorisation approach, the author presents parameterisation methods for stabilising controllers. The parameterisations of this study are characterised by an ideal finitely generated by some strictly causal stable transfer functions. Several typical examples of the parameterisations are also presented, namely (i) all stabilising controllers such that their relative degrees are more than or equal to some fixed number in the continuous-time linear time-invariant (LTI) system model; (ii) all stabilising controllers such that they must have at least some fixed number of delay operators in the discrete-time LTI system model; (iii) all stabilising controllers such that they must have some delay operators in the multidimensional system model. The parameterisation method of this study is also applied to (iv) a system that is stabilisable but that does not admit a doubly coprime factorisation.

### Refereed Proceeding Papers

- [k-mori-02:2012] K. Mori. Two-Stage Compensator Designs with Partial Feedbacks. In *Proceedings of International Conference on Control, Automation, Robotics and Vision (ICCARV 2012)*, pages 283–289, 2012.

The two-stage compensator designs of linear system are investigated in the framework of the factorization approach. First, we give “full feedback” two-stage compensator design. Based on this result, various types of the two-stage compensator designs with partial feedbacks are derived.

- [k-mori-03:2012] K. Mori. Two-Stage Compensator Designs with Partial Feedbacks. In *Proceedings of International Conference on Control, Automation and Robotics (ICCAR 2012)*, pages 1195–1200, 2012.

The two-stage compensator designs for single-input single-output plants are investigated. In this paper, we do not assume the coprime factorizability of the model. We first show that even if we do not consider the coprime factorizability, the classical result of the two-stage compensator design holds. We then show other two-stage compensator designs, which are related with input-output relations.

- [k-mori-04:2012] K. Mori. Two-Stage Compensator Designs without Coprime Factorizability. In *Proceedings of the 20th International Symposium on Mathematical Theory of Networks and Systems Melbourne Australia (MTNS12)*, pages 237(1–8), 2012.

The two-stage compensator designs for multi-input multi-output plants are investigated. We do not assume the coprime factorizability of models. We first show that even if we do not consider the coprime factorizability, the classical result of the two-stage compensator design holds. We then show other two-stage compensator designs, which are related with input-output relations. We further give partial parametrization methods. Their parametrizations are, in general, partial. Even so, the number of parameters are reduced from the previous result. The results of this paper are based on the factorization approach only, so that they can be applied to numerous linear systems.

- [k-mori-05:2012] K. Mori. Singular Points of Two-Stage Compensator Designs — Single-Input Single-Output Case —. In *Proceedings of International Conference on Modelling, Identification and Control Engineering (ICMICE 2012)*, pages 1003–1008, 2012.

The two-stage compensator designs for single-input single-output plants are considered. We present two-stage compensator designs based on the input and the output relations. We also show that there exist stabilizing controllers such that they cannot be obtained by the two-stage compensator designs but they are obtained by its parameterization. We investigate criteria of the existence of such stabilizing controllers.

- [k-mori-06:2012] K. Mori. Partial Feedback Two-Stage Compensator Designs without Coprime Factorizability. In *The 2nd Austrian Control Conference (AUCC 2012)*, pages 116–121, 2012.

The two-stage compensator designs for multi-input multi-output plants are investigated. We do not assume the coprime factorizability of models. We consider other two-stage compensator designs, in which we consider partial feedbacks in the sense of input-output relations. Then we give alternative partial parametrization methods without coprime factorizability.