System Analysis Laboratory

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Professor

In AY2016, a member, Dr.Mori, of the System Analysis Laboratory mainly, continues to investigate the theory of stabilizing theory. He also investigated the cyber physical system with his graduated students.

We have considered the models in which some plants admit and in which some plants do not admit coprime factorization. We have investigated the number of parametrization of stabilizing controllers. In the case of Anantharam's Example, we have known that the plant can be parametrized by only one parameter. On the other hand, we have shown that the maximum number is only three. Further, we have revealed the case where there need three parameters.

In recent years, there is great interest in cyber physical systems that tightly integrate physical systems and information systems from the development of computers and networks. However, since the cyber physical system is directly linked with the physical condition, it may cause a big accident when the stops of a takeover and the service occur once.

From the above, cyber physical systems are prone to failures and attacks on their physical infrastructure, and cyber attacks on their data management and communication layer. Previously cyber attacks were primarily attacks on "information systems," but in late years came to be turned to "the control system" of large-scale facilities. Most of the information in the facility is digitized and stored in the information system. If confidential information leaks from there, it will trigger further attacks. When the information in the facility is clarified, the attacker first falls down the information system, then the control system is targeted and the facilities are damaged. Therefore, it is necessary to construct and operate a secure system in order to operate the cyber physical system.

However, there are cases in which cyber physical system is used well. The

conception of Smart City is related predominantly with amalgamation of ICT with systems and processes of the city (such as urban social and physical infrastructures, comprising: Water, energy, transportation, buildings, administrative services, communications, and so on)with the goal to attain optimum efficiency of these systems and processes, or added features that are not likely to obtain without Information and Communication Technology (ICT), or novel techniques of checking, relating and analyzing these systems and processes. In the contemporary digital sphere, a substantial alteration is happening for the efficient management of city's physical infrastructures and systems including infrastructures of public service and utility, disaster management, mobile health, transportation, telemedicine, etc. Consequently, CPS has a huge role to play in contemporary smart city applications.

In recent years, advances in cyber-physical systems, big data, cloud computing, and industrial wireless networks have driven the implementation of Industry 4.0. These few examples already show that the product as well as the production systems itself exist not only as a physical entity, but also have a virtual representation. Both aspects are combined in Cyber-Physical Production Systems (CPPS) that allow the integration of production data (e.g. machine parameters or data from quality checks) and sensor data gathered by autonomous agents in the production in a virtual representation of the product. This data can be analyzed to get deeper insights on the manufacturing process on the one hand for the human as the process expert and on the other hand for the machines as autonomous entities on the shop floor.

In the scheduling using the cyber physical system until now, the job scheduler that adjusts the external signal was stopped for the job in which the delay occurred, and only the job without delay was executed. Since the delayed job is stopped for safety, the overall performance will be lower than the original performance. We, in this research, have proposed a job schedule that stabilizes the operation of the system model by performing job scheduling using the concept of the cyber physical system and can operate the attack signal as much as possible against an attack signal such as disturbance.

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

Refereed proceedings of an academic conference

[k-mori-104-009-02:2016] K. MORI and K. HASHIMOTO. 3-D Visualization and Optimization of Input-Output Relation for Linear Systems Using Parametrization of Two-Stage Compensator Design. In *Proceedings of The 2016 International Conference of Electrical and Electronics Engineering*, pages 328–332, 2016.

[k-mori-104-009-03:2016] K. MORI. Number of Parameters of Anantharam's Model with Single-Input Single-Output Case. In *Proceedings of The 18th International Conference on Automatic Control, Telecommunications, Signals and Systems*, pages 349–353, 2016.

Academic society activities

[k-mori-104-009-04:2016] K. MORI, 2016.

Counsel, SICE, Tohoku Branch

[k-mori-104-009-05:2016] K. MORI, 2016.

General Chair, 306th Reserch Conference, SICE, Tohoku Branch

Other significant contribution toward university planning, management, or administration

[k-mori-104-009-06:2016] Dr. Mori has created Problems of PC Koshien

Did you participate in Public Lectures, and/or Open Campus? (Yes or No) If yes, please describe what you did.

Summary of Achievement

[k-mori-104-009-07:2016] Dr. Mori held three public lectures for building PC computers.