Proposal of special session Organizer: Takami Matsuo, Oita University Special Session Title : Recent Advances in Adaptive Applications

Theme of the session:

Many engineering problems demand automatic control in the presence of uncertainties in systems. In such cases, adaptive schemes are strong structure to compensate for the variations. This session focus on topics of recent developments in the adaptive control and estimation techniques for mechatronic systems, biological systems, and power systems.

List of paper titles:

1. **Paper Title (Tentative)**: On-line Learning of Feedforward Control in Two-degree-of-freedom Structure

Authors: Kenji Sugimoto and Fuyuki Ito (Nara Institute of Science and Technology) Corresponding author: Kenji Sugimoto (Nara Institute of Science and Technology) Abstract: Feedback Error Learning is a model proposed by Kawato for biological voluntary motion control. With feedback control fixed, only feedforward control is tuned to improve response property. The two-degree-of-freedom structure with adaptation in this sense has been extensively studied in control engineering. In this paper we overview existing schemes for FEL and consider its potential application to mechatronics.

2. **Paper Title** : An adaptive control of a Robotic System to Prevent Sleep Apnea Syndrome (SAS)

Authors: Kazuya Sato, Masanori Tanaka (Saga University)

Corresponding author: Kazuya Sato (Saga University)

Abstract: In this paper, we develop an automatic judgement system of apnea state and a adaptive control of a robotic arm system which stimulates turning over in bed for SAS patients only using non-contact type sensors. It is known to be a origin that a root of the tongue occludes the respiratory tract as for the factor of the SAS when a patient sleeps on one's back. Our system can monitor a snoring sound and the sleeping posture of the patient through a microphone and a camera, respectively, and judge an apnea state based on the measurement data, automatically. Then a robotic arm is controlled by adaptive control and touches a part of a patient's body to make a defection. According to this system, the robot system does not have to break a style at the time of the normal sleeping situation of the patient, because a robotic arm just only contact a patient to derive the turning over in bed.

 Paper Title : On the adaptive observer for summational type state equations Authors: Kenji Sawada, Ryo Yanagawa and Seiichi Shin (The University of Electro-Communications)

Corresponding author: Kenji Sawada (The University of Electro-Communications) **Abstract**: This paper considers an adaptive observer construction for summational type state space (STSS) equation, which is a suitable mathematical expression for modeling physical dynamical systems with parasitic elements. It is well known that this expression is appropriate to the realities of physical and engineering problems in terms of the system identification and the control system design. However, little is, insofar as the authors are aware, known about the STSS identification methods except the MOESP based method. Motivated by this, we propose a STSS adaptive observer method, which is based on Kreisselmeier adaptive observer and constant-trace algorithm. To show the effectiveness, we apply the algorithm to the air-conditioner modelling. It is clarified that the algorithm allows us to estimate the indoor environment and external factors changing the amount of heat in the room.

4. **Paper Title** : Parameter Estimation of Heart Rhythm Dynamics Using Adaptive Observer

Authors: Keisuke Imamasu, Chisato Matoba, Haruo Suemitsu and Takami Matsuo(Oita University)

Corresponding author: Takami Matsuo(Oita University)

Abstract: The dynamics of cardiovascular rhythms have been widely studied due to the key aspects of the heart in the physiology of living beings. Cardiac rhythms can be either periodic or chaotic, being respectively related to normal and pathological physiological functioning. In this report, we analyze the dynamics of cardiovascular rhythms based on both the model-based approach and the non-model based approach. The former is done by the adaptive observer and the latter is by the instantaneous Lyapunov exponent.

5. **Paper Title** : Improvement of EMC in MPPT Control of Photovoltaic System Using Adaptive Observer

Authors: Tsuyoshi Ohba, Risa Matsuda, Haruo Suemitsu and Takami Matsuo Corresponding author: Takami Matsuo(Oita University)

Abstract: The output characteristic of a photovoltaic array is nonlinear and changes with solar irradiation and cell's temperature. The Maximum Power Point Tracking (MPPT) technique is needed to maximize the produced energy. Most MPPT techniques contains the time derivative of the current and the voltage. These electric signals are disturbed by the high frequency noises such as the switching noises of the power device. The low-pass filter is employed to reduce the noises of the circuit. However, the estimation error occurs in calculating the maximum power point. Thus, we apply the adaptive observer to estimate the time derivative of noisy signals. Moreover, we improve the Perturb and Observe method and the Incremental Conductance method by using the adaptive observer.