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# Honoree Keynote No. MON-AM1

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Time: **xx-xx**

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Chair: TBN, CC

Venue: xxx

## *Reproductive Medicine by Artificial Intelligence*

**ABSTRACT:** Currently, there are a lot of active studies in the medical and healthcare field using information technology and artificial intelligence (AI). In this talk, I will focus on the fusion research of AI and reproductive medicine, and discuss the usefulness. I will talk about the following topics.

(1) Detection of thick seminiferous tubules in the testicles: In micro-TESE surgery is performed using a microscope, and the seminiferous tubules that produce sperm are removed, and the sperm is collected from the removed seminiferous tubules. This sperm collection surgery for patients with non-obstructive azoospermia requires incision of the testes. This damage needs to be minimized, and this cost must be saved. Therefore, it is required for both surgeons and patients to non-invasively detect the presence of sperm in the testes before this operation. In this study, we detect the seminiferous tubules with a diameter of 250-300 $\mu$ m that can recover sperm using ultrasound technique. However, currently used ultrasonic waves of about 8 MHz cannot find a fine tube of this diameter by the low resolution. Thus, we found a characteristic that the peak frequency of the ultrasonic reflected wave is proportional to the reciprocal of the diameter, and estimated the diameter of the seminiferous tubule present in the testicle based on fuzzy inference.

(2) Supporting of ovum collection surgery: At the time of surgery to collect ova, an ultrasonic system is generally used. However, the follicles watched by the ultrasound system do not always contain ovum, and there are follicles that do not contain ovum is called vacuole. It is not possible in terms of resolution to confirm the vacuoles with ultrasound images before their removal, and the presence or absence of ovum is only known after collection. Therefore, we developed detection software of vacuoles using AI.

(3) Determining the insertion position of sperm that does not cause rupture on the ovum: In micro-insemination, a sperm is directly injected into an ovum collected from a woman using a pipette. When injecting sperm, the oval cell membrane is usually sufficiently extended with a pipette, and then rupture is performed by piezo pulse. However, rupture may occur during the development of the membrane, in which

case the insemination rate is reduced. Therefore, we quantitatively evaluate the effect of puncture position on ruptured membrane from ovum images during micro-insemination, and develop a system that can perform puncture based on the evaluation.

(4) Analysis of peristalsis of the uterus: The uterus performs a movement called uterine peristalsis to transport sperm. It is known that the direction and frequency of uterine peristalsis change according to the menstrual cycle. We developed a system to evaluate peristalsis of the uterus by Cine-MRI analysis, and an evaluation system of peristaltic movement frequency by the clinical ultrasonic image analysis.

Finally, I would like to consider the future role of AI in the medical and health fields.

**Bio: Yutaka Hata** is Professor in the Graduate School of Simulation Studies, University of Hyogo, Japan. He received the B.E. degree (Electronics) in 1984, the M.E. degree (Electrical Engineering and Electronics) in 1986 and the Ph.D. (Doctor of Engineering) in 1989 all from Himeji Institute of Technology, Japan. He is currently a Professor in the Graduate School of Simulation Studies, University of Hyogo, Japan. He is also a Guest Professor in World Premier International Research Center, Immunology Frontier Research Center, Osaka University, Japan. He spent one year in BISC Group, University of California at Berkeley from 1995 to 1996 as a visiting scholar.

His research interests are in medical imaging, Bio-signal processing, human health monitoring, and fuzzy system. He received 21 awards such as the Franklin V. Taylor Best Paper Award (IEEE SMC 2009), World Automation Congress Lifetime Achievement Award (2008), Biomedical Wellness Award (SPIE Defense, Security, and Sensing 2010) and Hyogo Scientific Excellence Award (Hyogo Prefecture, 2019). He is editors including IEEE Trans on SMC-Systems. He is an IEEE Fellow.