Chair Bioproduction Engineering

2.5.12 Laboratory: Agriculural Systems Engineering

Member:	Professor	Hiroshi Shimizu
	Associate Professor	Hiroshi Nakashima
	Assistant Professor	Juro Miyasaka
	Assistant Professor	Katsuaki Ohdoi
	Doctor's program	2
	Master's Program	5
	Undergraduate	6

A. Research Activities (2010.4-2011.3)

A-1. Main Subjects

a) Environment Control for Plant Factory

Plant growth is generally influenced by the environment such as temperature, light intensity and so on. If this phenomenon is used conversely, it may be considered that plant growth can be controllable by changing cultivation environment artificially. Among the cultivation environments, researches on light and temperature factors have been conducting in our laboratory. Especially, effect of light intensity, quality (spectrum) and photoperiod, and difference between day and night temperatures on plant growth is evaluated. Based on the knowledge from the research, we try to find an optimum environment conditions to grow plant. The result of this study is utilized as basic knowledge of the environmental control technology in the agricultural production facilities such as plant factory, and the creation of the environment condition to get ideally growth in the smallest energy input is the final goal of this project.

b) Terramechanics

(1) Performance of an off-road tire depends on the contact dynamics between soil and tread pattern of tire. Tire and subsoil are modeled by the finite element method (FEM), while the top soil where a tire travels is modeled by the discrete element method (DEM), and FE-DEM is applied to the prediction of tire performance on deformable terrain. (2) DEM is applied to such soil flows or wheel performance analysis in reduced gravity environment encountered in lunar or planetary exploration.
 (3) Soil cutting is simple and fundamental topic in agricultural or construction machinery. Application of DEM or GEM has been studied along with the precise correlative experiments. (4) The effect of grouser for tracked vehicles has been studied in terms of grouser parameters using DEM with slip-sinkage effect. (5) Growth and enlargement of a plant root has been modelled as a contact of soil and root by DEM, or FE-DEM.

c) Development of electric agricultural vehicle using microwave power transmission

A no-emission vehicle is under development in order to contribute the environmental conservation. A test electric vehicle, which has no battery but only electric motors which are driven by electricity transmitted in form of microwave, is designed, made and tested. In order to improve the transmission efficiency a parabola antenna, direction control of antennae and a radio data transmission method are tried. Effects of microwave on plant growth are also investigated.

A-2.Publications and presentations

a) Publications

Books

- Naoshi Kondo, Takahisa Nishizu, Yuichi Ogawa, Takahiro Hayashi, Hiroshi Shimizu and Kiyokazu Goto Edts. Physical Property of Agricultural Products, CORONA PUBLISHING CO.,LTD. 2010

- Chanseok RYU, Masahiko SUGURI, Michihisa IIDA, Katsuaki OHDOI and Mikio UMEDA A utilization manual of wastewater from anaerobic digester at paddy fields and burning of compost Chapter 2 Utilization of wastewater for cultivation of paddy rice as staple food Livestock Industry's Environmental Improvement Organization, 2011

Original Papers(including book-reviews)

- Noriko TAKAHASHI, Naoshi KONDO, Nguyen Quoc TUAN, Shoichi MANO, Tomoo SHIIGI, Hiroshi SHIMIZU, Moriyuki FUKUSHIMA, Fumiyuki IWAKI, Osamu WATANABE, Kazuyuki FUKUZONO and Mamoru NAKANO. Serum Vitamin A Level Measurement in Slaughtered and Live Cattle Using Multispectral Imaging(査読有り), Engineering in Agriculture, Environment and Food, 3:42-46, 2010

- Shinone, H., H. Nakashima, Y. Takatsu, T. Kasetani, H. Matsukawa, H. Shimizu, J. Miyasaka, and K. Ohdoi: Experimental Analysis of Tread Pattern Effects on Tire Tractive Performance on Sand using an Indoor Traction Measurement System with Forced-slip Mechanism. Engineering in Agriculture, Environment and Food, 3(2); 61-66, 2010.

- Nakashima, H., H. Fujii, A. Oida, M. Momozu, H. Kanamori, S. Aoki, T. Yokoyama, H. Shimizu, J. Miyasaka, and K. Ohdoi: Discrete element method analysis of single wheel performance for a small lunar rover on sloped terrain. Journal of Terramechanics, 47(5); 307-321, 2010.

- Nakashima, H., Y. Shioji, T. Kobayashi, S. Aoki, H. Shimizu, J. Miyasaka, and K. Ohdoi:Determining the angle of repose of sand under low-gravity conditions using discrete element method. Journal of Terramechanics, 48(1); 17-26, 2011.

- Fujita, Y., H. Nakashima, H. Tanaka, J. Miyasaka, K. Ohdoi, and H. Shimizu: Numerical simulation of thickening growth of radish root. Proc. 5th International Symposium on Machinery and Mechatronics for Agriculture and Biosystems Engineering (ISMAB), Fukuoka, 2010. (CD-ROM)

- Nakahima, H., X. L. Wang, H. Shimizu, J. Miyasaka, and K. Ohdoi: Numerical analysis of traction generated at grouser-soil interface. Proc. 9th Asia-Pacific Conference of ISTVS, Sapporo, 2010. (CD-ROM)

- Ono, T., H. Nakahima, H. Shimizu, J. Miyasaka, K. Ohdoi: FE-DEM analysis of tractive performance of an elastic wheel for planetary rover. Proc. 9th Asia-Pacific Conference of ISTVS, Sapporo, 2010. (CD-ROM)

- Sakamoto, H., H. Nakahima, H. Shimizu, J. Miyasaka, and K. Ohdoi: 3D discrete element analysis of cone penetration resistance using mesoscopic soil model. Proc. 9th Asia-Pacific Conference of ISTVS, Sapporo, 2010. (CD-ROM)

- Fujita, Y., H. Nakashima, H. Tanaka, J. Miyasaka, K. Ohdoi, and H. Shimizu: 3D FE-DEM simulation of a thickening growth model for Japanese radish root. Preprint, IFAC Conference AgriControl 2010, Kyoto, 2010. (CD-ROM)

- Ono, T., H. Nakashima, H. Shimizu, J. Miyasaka, and K. Ohdoi: Analysis of elastic wheel performance for off-road mobile robots using FEDEM. Preprint, IFAC Conference AgriControl 2010, Kyoto, 2010. (CD-ROM)

- Sakamoto, H., H. Nakashima, H. Shimizu, J. Miyasaka, and K. Ohdoi: 2D DEM analysis of cone penetration resistance on mesoscopic soil model. Preprint, IFAC Conference AgriControl 2010, Kyoto, 2010. (CD-ROM)

- Iida, M., H. Tomiyama, T.H. Oh, and H. Nakashima: Steering/Braking Control of Articulated Vehicle for Small Turning, Preprint, IFAC Conference AgriControl 2010, Kyoto, 2010. (CD-ROM)

 - Katsuaki OHDOI, Akihiro HIRAO, Chanseok RYU, Michihisa IIDA, Masahiko SUGURI, Hiroshi SHIMIZU, Hiroshi NAKASHIMA and Juro MIYASAKA
 Study of Utilization System of Digested Slurry as Liquid Fertilizer
 Transactions of the Japanese Society of Irrigation, Drainage and Rural Engineering (The section of resource recycling), 6: 89-97, 2010

- Chanseok RYU, Jun NAKADE, Masahiko SUGURI, Michihisa IIDA, Katsuaki OHDOI and Mikio UMEDA

Proposing Growing Guideline to Promote the Use of Methane Fermentation Digested Sludge as a Liquid Fertilizer for Rice Production -Trials at paddy fields in Nantan city in Kyoto Prefecture-Transactions of the Japanese Society of Irrigation, Drainage and Rural Engineering (The section of resource recycling), 6: 99-114, 2010

Reviews

- Hiroshi Shimizu and Toru Torii. New Evolution of Intelligent Solar Plant Factory [12]. Agriculture and Horticulture 85(12): 1219-1226, 2010.

- Nakashima, H.: Systems, control and information for food production in agriculture, Systems, Control and Information, 54(4); 128-131, 2010.

- Juro Miyasaka: Modelling and Optimization for Agricultural Production Systems, SYSTEMs, CONTROL ANDINFORMATION, 54(4), pp138-143, 2010

Reports, others

- Yuta Saito, Hiroshi Shimizu, Hiroshi Namashima, Juro Miyasaka, Katsuaki Ohdoi. Effect of light quality on lettuce growth - Evaluation of photosynthesis rate under LED light- , Kansai Branch Report of JSAM; 108,25,2010.

- NAKAGAWA, S., Y. YAMANAKA, K. OHDOI, J. MIYASAKA, H. SHIMIZU, H. NAKASHIMA, K. HASHIMOTO, N. SHINOHARA and T. MITANI: Development of an Electric Vehicle by Microwave Power Transmission, IFAC Conference AgriControl 2010, Kyoto, 2010(CD-ROM).

- IGUCHI, H., J. MIYASAKA, Y. OGAWA, H. SHIMIZU, H. NAKASHIMA, K. OHDOI, N. SHINOHARA and T. MITANI:
Effects of Microwave on Plant Growth after Germination -Measurement of Spinach Seed Growth by Image Processing-,
TECHNICAL REPORT OF IEICE, SPS2010-23(2011-03).

 Michihisa IIDA, Chanseok RYU, Katsuaki OHDOI, Kimihito NAKAMURA and Masahiko SUGURI
 Utilization of Digested Sludge for Paddy Rice as Liquid Fertilizer
 Reports of Japanese Society of Agricultural Machinery: 42-48

b) Conference and seminar papers presented

- Annual International Meeting 2010, ASABE(1件) 清水

- Annual meeting Japanese Society of Agricultural, Biological and Environmental Engineers and Scientists 2010 (1) 斎藤

- AGRICONTROL 2010 IFAC International Conference(1件) 斎藤

- 125nd Kansai Branch Meeting, JSAM (1) 小林

- International Conference "Engineering Problems in Agriculture and Industry"(1件) 清水

- 69th Annual Meeting, JSAM (4 papers) 中嶋

- 125th Meeting, Kansai Branch of JSAM (1 papers) 中嶋

- Annual meeting Japanese Society of Agricultural, Biological and Environmental Engineers and Scientists 2010 (1) 宮坂

- 125nd Kansai Branch Meeting, JSAM (1) 井口

- 10th Meeting of SPS Technical Group (1) 宮坂

- AGRICONTROL 2010 IFAC International Conference(1) 中川

- 69th Annual Meeting Japanese Society of Agricultural Machinery (1) OHDOI

- AGRICONTROL 2010 IFAC International Conference (1) MORI

- Annual Meeting Japanese Society of Irrigation, Drainage and Rural Engineering (The section of resource recycling) (2) OHDOI

- 125nd Kansai Branch Meeting, JSAM (1) HIRAO

A-3.Off-campus activities 1

Membership in academic societies

- Shimizu, Hiroshi, D. Agric. Sci : Japanese Society of Agricultural, Biological and Environmental Engineers and Scientist (Assistant to President), Japanese Society of Agricultural Machinery (Chair of Information Comittee), The Society of Instrument and Control Engineers (Vice Chair of Biosystem Panel), Japanese Society of Farm Work Research (Councilor), Japanese Society of Agricultural Infomatics (Councilor), Research group for Phyto-Technology (Councilor)

- Hiroshi Nakashima : JSAM(Councilor, Member of Editorial Committee), Kansai Branch of JSAM(Secretary), Japanese Society for Terramechanics(Secretary, Member of Lunarmechanics Committee)

- iyasaka, Juro, M. Agric. Sci : The Japanese Society of Agricultural Machinery (JSAM), Kansai Branch of JSAM (Member of Planning Committee), Japanese Society of Farm Work Research, Japanese Society for Terramechanics, Society for Phytotechnology, Society for Science on Form (Financial Secretary)

- Ohdoi, Katsuaki, D. Agric. Sci : Japanese Society of Agricultural Machinery, Japanese Society of Farm Work Research, Research group for Phyto-Technology

Membership in Science Council of Japan, etc.

- Shimizu, Hiroshi, D. Agric. Sci : The Science Council of Japan, Sectional Committee for Agricultural Information System (Observer)

A-3.Off-campus activities 2

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Scientific Research (B) : Hiroshi Shimizu : Development of environment control using gene expression analysis

- Scientific Research (B) : Michihisa IIDA : Study of High Level Automation and Information for Harvesting System by Robot Combine Hervester

A-4.International cooperations and overseas activities 1

Membership in academic societies

- Shimizu,Hiroshi,D.Agric.Sci: American Society of Agricultural and Biological Engineers, Asian Association for Agricultural Engineering (Vice President)

- Hiroshi Nakashima,D.Agric.Sci: International Society for Terrain-Vehicle Systems (Secratariat of Japan, Associate Editor of Journal of Terramechanics)

- Miyasaka, Juro, M. Agric, Sci: International Society for Terrain-Vehicle Systems, Asian Association for Agricultural Engineering

- Ohdoi, Katsuaki, D. Agric. Sci: Asian Association for Agricultural Engineering

International meetings(country,roles)

- Shimizu,Hiroshi,D.Agric.Sci:Annual International Meeting 2010, ASABE(US, Presentation), International Conference "Engineering Problems in Agriculture and Industry"(Mongolia, Invited Speech)

- Hiroshi Nakashima,D.Agric.Sci: Asia-Pacific ISTVS Conference (Member of Executive Committee, Chairman), IFAC Agricontrol(Member of Executive Committee, Member of Program Committee, Editor)

- Miyasaka, Juro, M. Agric, Sci: AGRICONTROL 2010 IFAC International Conference

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level: Introduction to Agricultural and Environmental Engineering 2(shimizu		
shared), Electrical Engineering and Electronics(Shimizu), Mathematical		
Programming(Shimizu), Energy and Prime Movers in Agriculture(Shimizu),		
Seminar in Agricultural and Environmental		
Engineering(Shimizu,Nakashima,Miyasaka and Ohdoi), On the Job Training		
for Agricultural Engineering(Shimizu shared)Outline of Agricultural Science	;	
II(shared), Applied Mechanics(shared), Strength of Materials(Nakashima),		
Practice in Data Processing II(shared), Laboratory Course in Agricultural		
Machinery I(shared), Laboratory Course in Agricultural Machinery II(shared))	
- Graduate level: Seminar in Agricultural Systems Engineering 1(Shimizu, Nakashima shared),	Seminar in Agricultural Systems Engineering 1(Shimizu, Nakashima shared),	
Seminar in Agriculture System Engineering		
2(Shimizu, Nakashima, Miyasaka, Ohdoi shared), Laboratory Course in	2(Shimizu, Nakashima, Miyasaka, Ohdoi shared), Laboratory Course in	
Agricultural System Engineering(Shimizu,Nakashima,Miyasaka,Ohdoi	Agricultural System Engineering(Shimizu,Nakashima,Miyasaka,Ohdoi	
shared)		

C.Other Remarks

- Miyasaka, Juro: Committee for the METLAB (Microwave Energy Transmission Laboratory) Interuniversity and International Collaborative Research