2.5.12 Laboratory : Agricultural Systems Engineering

Member :	Professor	Shimizu, Hiroshi, D. Agric. Sci
	Associate Professor	Nakashima, Hiroshi, D. Agric. Sci
	Assistant Professor	Miyasaka, Juro, M. Agric. Sci
	Assistant Professor	Ohdoi Katsuaki , D. Agric. Sci
	Master's Program	6
	Undergraduate	6

A. Research Activities (2009.4-2010.3)

A-1. Main Subjects

a) The environmental control technology in the agricultural production facilities

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

The Discrete Element Method is applied to elucidate the interaction between machine parts and soil. We are now simulating the soil behavior caused by a tire. Some effective methods are under study, such as combining DEM and FEM, or parallel processing of DEM. Experimental researches on tire mobility by using an indoor soil bin and tri-axial contact reaction measurement at tire-soil interface are also conducted. Moreover, numerical analysis of turning behavior of articulate-frame steering vehicle has been studied.The Discrete Element Method is applied to elucidate the interaction between machine parts and soil. We are now simulating the soil behavior caused by a tire.

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.

d) Systems engineering study on farm management, mechanization and rural development

The optimum cultivation system is studied to maximize the income of competitive vegetable farmer by means of a simulated annealing method. In order to decrease the cost of agricultural machine, the method to optimize the farm work schedules was developed by genetic algorithm. Moreover, this method was applied to decide the necessary number of staff and facilities when the effluent of anaerobic digestion was applied to farm field as a liquid fertilizer.

e) Biomass energy

It is clear that the fossil energy resources will be exhausted and the energy production by way of recycling agricultural wastes will be one of the necessary technologies in future. We are now investigating the efficient production of methane gas.

f) Root growth simulation

An approach of model construction by applying dynamic contact interaction has been studied.

A-2.Publications and presentations

a) Publications

Original Papers

- Shinone,H., H.Nakashima, Y. Takatsu, T. Kasetani, H. Matsukawa, H. Shimizu, J. Miyasaka, 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

- Takahashi,N., N. Kondo, N. Q. Tuan, S.Mano, T. Shiigi, H. Shimizu, M. Fukushima, F. Iwaki, O. Watanabe, K. Fukuzono, M. Nakano:
Serum Vitamin A Level Measurement in Slaughtered and Live Cattle Using Multispectral Imaging.Engineering in Agriculture, Environment and Food,3(2); 42-46,2010

- Kasetani,T., H. Nakashima, H. Shinone, H.Shimizu, J. Miyasaka and K. Ohdoi:
Tri-axial Contact Reaction at the Tire-Soil Interface.Engineering in Agriculture,Environment and Food,3(1);14-19,2010
- Ryu,C.S., M.Suguri, M.Iida, K.Ohdoi, M.Umeda:
Application of Methane Fermentation Digested Sludge to Large Scale Paddy as Fertilizer.Transactions of the Japanese Society of Irrigation, Drainage and Rural Engineering (The section of resource recycling), 5; 77-94,2009
- Ohdoi, K., R. Mori, M. Iida, C.S. Ryu:
Optimization of the Schedule for Transport and Application of Wastewater from Anaerobic Digester as Liquid Fertilizer -Measurement and Modeling of Working Hours at Field-.
Transactions of the Japanese Society of Irrigation, Drainage and Rural Engineering (The section of resource recycling), 5;57-76,2009
- Kondo,N., K.Tanihara, T. Shiigi, H. Shimizu, M. Kurita, M. Tsutsumi, S. Taniwaki, V. K. Chong:
Path-Planning of Tomato-Cluster Harvesting Robot to Realize Low Vibration and speedy Transportation. Engineering in Agriculture, Environment and Food,2(3);108-115,2009
- Matsumoto,K., Y.Tada, H. Shimizu, S.Shibusawa:
Effect of light intensity on growth and antioxdative activity of Raphanus sativus L. 'Kaiwaredaikon'.
Journal of Science and High Technology in Agriculture,21(3); 117-122,2009
- Matsumoto,K., Y.Tada, H. Shimizu, S.Shibusawa:Effect of water supply levels on growth and antioxdative activity of Raphanus sativus L. 'Kaiwaredaikon (Japanese radish sprout)'
Journal of Science and High Technology in Agriculture,21(2);79-85,2009
- Shimizu,H.,Y.Tsushima,N.Kondo,T.Shiigi,T.Nishizu,V.K.Chong:
Classification of the stem elongation pattern in ornamental plants under the different day and night temperature conditions.Engineering in Agriculture,Environment and Food,2(2);72-77,2009
- Kondo,N.,K.Yamamoto,H.Shimizu,K.Yata,M.Kurita,T.Shiigi,M.Monta,T.Nishizu:
A Machine Vision for Tomato Cluster Harvesting Robo.Engineering in Agriculture,Environment and Food,2(2);60-65,2009
- Kondo,N.,M.Kuramoto,H.Shimizu,Y.Ogawa,M.Kurita,T.Nishizu,V.K.Chong, K.Yamamoto:
Identification of Fluorescent Substance in Mandarin Orange Skin for Machine Vision System to Detect Rotten Citrus Fruits.Engineering in Agriculture,Environment and

Food,2(2);54-59,2009

Reports

- Nakashima,H., Y. Toki:
Attempt of accurate modeling for cone penetration resistance obtained from particulate media, Proc. Powders & Grains 2009, Golden, 421-424, 2009.
- Iida,M., H. Tomiyama, T. Oh, H. Nakashima, T. Nakamura:
Small turning behavior of an articulated vehicle by braking control. Fourth IFAC International Workshop on Bio-Robotics, Information Technology, and Intelligent Control for Bioproduction Systems, September 10--11, Champaign, IL, 2009. (CD-ROM)
- Nakahima,H., Y. Takatsu, T. Ono, H. Shimizu, J. Miyasaka, K. Ohdoi:
Method of traction analysis for an elastic wheel by FE-DEM, Proc. 11th European Conf. ISTVS, Bremen, October 5-8, 2009. (CD-ROM)
- Nakahima,H., H. Shimizu, J. Miyasaka, K. Ohdoi:
Experimental and numerical contact stresses at tire-soil interface on sand, Proc. 11th European Conf. ISTVS, Bremen, October 5-8, 2009. (CD-ROM)

- Kasetani, T., H. Nakashima, H. Shinone: Measurement of 3-axial contact reaction at sand terrain locomotion, Kansai Branch Report of JSAM, 106, 1, 2009.

- Nakashima, H., H. Sakamoto, Y. Toki: Characteristics of penetration resistance of cone using discrete model of soil, Kansai Branch Report of JSAM, 106, 2, 2009.

- Matsukawa, H., H. Nakashima, Y. Takatsu: Increasing accuracy in expressing tire deformation for FE-DEM, Kansai Branch Report of JSAM, 106, 3, 2009.

- Iida, M., H. Tomiyama, T. Oh, H. Nakashima, T. Nakamura: Measurement of turning performance of articulated frame-steering vehicle based on control of direct yaw moment, Kansai Branch Report of JSAM, 107, 32-35, 2009.
- Sakamoto, H., H. Nakashima, H. Shimizu, J. Miyasaka, K. Ohdoi: Discussion on mechanical parameters for increasing accuracy in DEM analysis, Kansai Branch Report of JSAM, 107, 36-37, 2009.
- Yamanaka, Y., S. Nakagawa, J. Miyasaka, K. Ohdoi, H. Shimizu, H. Nakashima: Development of Electric Vehicle Driven by Microwave Power Transmission, Kansai Branch Report of JSAM; 28-31, 2009
- Yamanaka, Y., S. Nakagawa, J. Miyasaka, K. Ohdoi, H. Nakashima, H. Shimizu: Development of an Electric Vehicle by Microwave Power Transmission - Development of a Small Model Vehicle and Control of Antennae with Wired Communication - . TECHNICAL REPORT OF IEICE, SPS2009-16(2010-03), 2010

- Mori, R., K. Ohdoi, M. Iida, M. Umeda:
Study on the Optimization of Application Plan for Liquid Fertilizer by Genetic Algorithm, Proceedings of XXXIII CIOSTA - CIGR V Conference 2009 (CDROM)

- Mori, R., K. Ohio, H. Nakashima; Optimization of application plan for digested slurry,Kansai Branch Report of JSAM; 106,4,2009

b) Conference and seminar papers presented

- International Agricultural Engineering Conference 2009(1)
- Annual meeting Japanese Society of Agricultural, Biological and Environmental Engineers and Scientists 2009 (2)
- Joint Conf. on Environmental Engineering in Agriculture 2009 (5)
- 122nd Kansai Branch Meeting, JSAM (4)
- 123rd Kansai Branch Meeting, JSAM (1)
- 30th Meeting of Japanese Society for Terramechanics (4)
- Powders & Grains 2009 (1)
- 11th European Conf. ISTVS (2)
- 9th Meeting of SPS Technical Group: (1)
- XXXIII CIOSTA-CIGR Section V Conference(1)

A-3.Off-campus activities

Membership in academic societies

- Shimizu, Hiroshi, D. Agric. Sci : Japanese Society of Agricultural, Biological and Environmental Engineers and Scientist (Vice President), Japanese Society of Agricultural Machinery (Editor of AABEA), The Society of Instrument and Control Engineers (Chair of Biosystem Panel) , Japanese Society of Farm Work Research (Councilor), Japanese Society of Agricultural Infomatics (Councilor)
- Nakashima, Hiroshi, D. Agric. Sci : JSAM(Councilor, Member of Editorial Committee), Kansai Branch, JSAM(Secretary), Japanese Society for Terramechanics (Director, Member of Lunar Mechanics Committee), JSME, JSCES, JGS, JSAI, Japanese Society for Root Research, Japanese Society of Agricultural, Biological and Environmental Engineers and Scientists
- Miyasaka, 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 : The Japanese Society of Agricultural Machinery (JSAM), Japanese Society of Farm Work Research

Research grants

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

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

2.Other Research Grants

- Subsidies for projects to promote the enhancement of manufacturing technology for small and medium enterprises : Hiroshi Shimizu : Development of organic plant factory utilized fermentation base technology
- SME production support aid 2009 (Verified support project) : Hiroshi Shimizu : Experimental proof for quantification of photosynthesis ability by spraying fermentation products for agriculture
- SME production support aid 2009 (Verified support project) : Hiroshi Shimizu : Experimental proof for effect of fermentation products for agriculture on Soil microbe multiplication
- SME production support aid 2009 (Verified support project) : Hiroshi Shimizu : Experimental proof for energy saving by LED installation in plant factory
- Joint Research with Caterpillar Japan : IIDA, Michihisa (Collaborator; Nakashima, Hiroshi) : Research on turning performance of wheel loader
- JST Comprehensive Support Program for Creation of Regional Innovation : Miyasaka Juro : Development of Information System for Cropping and Shipping of Kyoto Specialty Vegetable Mizuna
- Co-operation Research Project with The Japan Association of Rural Resource Recycling Solutions : Ohdoi Katsuaki : Optimization of transportation and application of liquid fertilizer by mathematical programming

A-4.International cooperation and overseas activities

Membership in academic societies

- Shimizu,Hiroshi,D.Agric.Sci: American Society of Agricultural and Biological Engineers, Asian Association for Agricultural Engineering
- Nakashima, Hiroshi, Dr. Agr. Sci: ISTVS(Secretariat of Japan; Editorial Board, Journal of Terramechanics), AAAE, ASME
- 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：GreenSys 2009 Conference
- Nakashima, Hiroshi, Dr. Agr. Sci：Powders & Grains 2009 (USA, presentation), 11th European Conf. ISTVS(Germany, Chairman, presentation)
- Ohdoi Katsuaki, D. Agric. Sci：XXXIII CIOSTA-CIGR Section V Conference

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level： Outline of Agricultural Science 2(Shimizu shared), Introduction to Agricultural and Environmental Engineering 2(shimizu shared), Applied Mechanics(Nakashima shared),Mechanics of Materials(Nakashima), Mathematical Programming(Shimizu), Energy and Prime Movers in Agriculture(Shimizu), Seminar in Agricultural and Environmental Engineering(Shimizu,Nakashima,Miyasaka and Ohdoi), Practice in Data Processing 2(Nakashima,Ohdoi shared), Laboratory Course in Agricultural Machinery 1(Nakashima,Miyasaka,Ohdoi shared), Laboratory Course in Agricultural Machinery 2(Nakashima,Miyasaka,Ohdoi shared), On the Job Training for Agricultural Engineering(Shimizu shared), Life/Food/Environment and Physics(Shimizu shared), Experiments in Physics(Ohdoi shared)
- Graduate level： Teramecanics(Nakashima), Seminar in Agricultural Systems Engineering 1(Shimizu,Nakashima shared), Seminar in Agriculture System Engineering 2(Shimizu,Nakashima,Miyasaka,Ohdoi shared), Laboratory Course in Agricultural System Engineering(Shimizu,Nakashima,Miyasaka,Ohdoi shared)

B-2.Off-campus teaching etc.

Part-time lecturer

- Hiroshi Shimizu: Ibaraki University, College of Agroculture(Instrumentation Engineering)

B-3.Overseas teaching

Lectures and seminars

- Shimizu,Hiroshi,D.Agric.Sci

Plant factory in Japan(Lecturer) : Asian Institute of Technology(Thailand)

Plant Factory; the 21st century technology for solving the world food crisis(Seminars) : Japan Association for Trade with Russia & NIS(Russia)

C.Other Remarks

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