RESEARCH REPORT

Name:	Affiliation (University):
Cantas ALEV	Ruhr University Bochum
Research Advisor:	**Host Institution:**
Takayuki ASAHARA	RIKEN Center for Developmental Biology Kobe
Research Subject: Role of Gap Junctional Communication in Stem Cell Differentiation	

1. Research Description:

In my PhD thesis at the Ruhr University Bochum I focused on functional genomic and proteomic approaches to unveil the potential role and function of gap junctional communication in differentiation and development. Gap junctions are specialized channels formed by members of the Connexin (Cx) gene family, that mediate cell-to-cell communication via direct passage of small molecules. Using cDNA Microarraytechnology, Real time RT-PCR, side directed mutagenesis studies and various proteome analytical methods we were able to show a regulation of an important differentiation associated signalling pathway by the C-terminal domain of the neuronal Connexin 36 (Cx36) in a neural crest stem cell line (RT4-AC). At the RIKEN Center for Developmental Biology I was mainly interested in further investigating the role of gap junctional communication in neural and non-neural stem cells focussing on the potential role of Connexins in transdifferentiation

2. Research Activities:

After learning the proper techniques for isolation, purification and cultivation of human endothelial progenitor cells from human peripheral blood and of murine neural stem cells from adult mouse brain I studied the effect of the gap junctional blocker 18β-glycyrrhetinic acid on the differentiation and proliferation properties of these cells. Coculture studies of human endothelial progenitor cells with murine cardiac myoblasts (H9C2) and with murine neural stem cells were performed, in order to study the potential effect of gap junctional blockade on transdifferentiation. Furthermore the effect of Sonic hedgehog (Shh), a factor vital for neural development, on endothelial progenitor cells and neural stem cells was analysed using different cellular and molecular approaches. For all experimental settings described above the Gen expression pattern of endothelial progenitor cells and neural stem cells was analysed focussing on changes in the expression of certain Connexins, neuronal and endothelial markers.

3. Perspective of Research after this Program:

I am very pleased with the nice scientific experiences and results I was able to gain during this short but fruitful time at the newly established RIKEN Center for Developmental Biology in Kobe. It was a great honor and invaluable experience to work together with Dr. Asahara and other excellent researchers in the field of Developmental Biology in such an exciting and stimulating scientific environment. Therefore I am very happy that I can come back to RIKEN CDB as a postdoctoral fellow right after finishing my PhD thesis in Germany middle of next year. Meanwhile we will, in collaboration with my laboratory in Germany, continue with the validation and further exploration of the promising experimental results gained during this program.

4. Advisor's Remarks:

I am pleased to report what Cantas has collaborated in this institute. He joined my lab this summer and has became an integral and highly valued member. He is already a highly skilled and imaginative investigator. He initiated his own project trial in stem cell biology. Co-culture study of endothelial progenitor cells and murine cardiac myoblasts demonstrated intriguing consequences for further investments in near future collaboration between our lab and him. The experiment of sonic hedgehog effect on endothelial progenitor cells may also yield promising field in vascular biology. During this very short period, he acquired further more than I expected. I was very happy to have him in my lab even for a short period, and hoping any further collaboration with him.

RESEARCH REPORT

Name:	**Affiliation (University):**
Ephraim Gräff	Kekulé-Institut für Organische Chemie und Biochemie der Rheinischen Friedrich-Wilhelms-Universität Bonn (Germany)
Research Advisor:	**Host Institution:**
Prof. Koichi Mikami	Tokyo Institute of Technology Department of Applied Chemistry

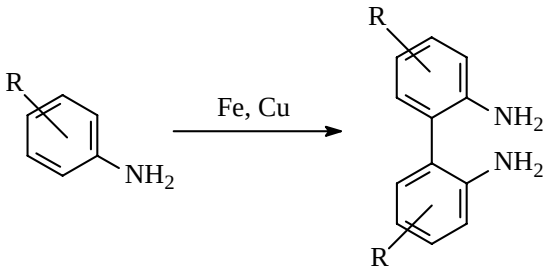
Research Subject:
Synthesis of substituted diaminobiphenyls as ligands in asymmetric catalysis

1. Research Description:

Asymmetric synthesis is one of the major research fields in modern organic chemistry. Therefore it is necessary to understand the origins and mechanisms that imply chirality in a molecule. To induce chirality in an organic synthesis, asymmetric catalysts bearing an asymmetric ligand coordinating a central metal atom are essential. In order to achieve high enantiomeric excesses, the organic ligand needs to form a suitable complex with the metal and has to offer a good transfer of chirality to the catalysed process. BINOL is such a ligand that has successfully been employed in many asymmetric catalytic processes. Nevertheless many improvements are possible by derivatisation of BINOL (i.e. DABN, BINAP) or by using complementary ligands like chiral diamines as sparteine or dpen. BIPHEB is also a very well known ligand, but in spite of the before mentioned it only gets chiral (atropos) in coordination to a metal atom.

2. Research Activities:

I have studied the oxidative coupling process of substituted anilines and naphthylamines to form biphenyls as ligands for asymmetric catalysts. Iron and copper have been already successfully utilized to couple phenols and naphthols. Iron shows catalytic activity in the reaction of naphthylamine to DABN. The reaction occurs at 0°C for 30 min. to yield 40% of racemic DABN. Also 3,5-xylidine, 2,3-xylidine, N,N-dimethylaniline, N,N-3,5-tetramethylaniline and 4-aminoresorcinol have been tested under several conditions for coupling reaction, but yielded with both copper or iron as catalyst only unsatisfactory amounts of product. It has shown that the main problem is a formation of sideproducts in an aromatic amination process. This reaction seems to be faster than the desired coupling reaction.



3. Perspective of Research after this Program:

This fellowship gave me the possibility to get an inside view into Japanese society, culture and research. These results may be useful to plan other strategies for obtaining chiral ligands. Further collaboration in this research field with Prof. K.H. Dötz may take place in future.

4. Advisor's Remarks:

As a part of program of my research collaboration with Professor K.H. Dötz of the University of Bonn, Germany, I invited Ephraim Gräff to Japan, who is a ph. D course student in the institute. He stayed in my laboratory for about 7 weeks under the summer program for stay in Japan. I believe that he has enjoyed his life in Japan and also learned various recently developed techniques in preparing chiral diamine ligands utilized in asymmetric catalysis. I am sure that this experience in Japan would facilitate his projects in his graduate program in Bonn University.

RESEARCH REPORT

Name: Stefan Heinrichs **Affiliation:** University of Konstanz, Germany	
Research Advisor: Prof. Yamamoto **Host Institution:** Tokyo University	
Research Subject: Analysis and Modelling of Heartbeat Time Series	

1. **Research Description:**

The analysis of physiological time series with methods motivated by statistical physics is a rapidly growing field and yields potentially very sensitive tools to detect changes of physiological parameters not directly accessible by examining the raw data. During my stay I investigated the heartbeat of patients showing atrial fibrillation (AF), which is a cardiac arrhythmia where the normal pace making by the sinus node is dysfunctional. Instead, the rhythm originates from the complex interplay of self-excitation in the atrium and the conduction through the AV node connecting the atrium to the ventricle. The resulting excitation frequencies in the atrium would not allow for an efficient pumping function of the ventricle and only the special properties of the AV node acting as a filter allow these patients to live. Therefore, it is likely that parameters describing the properties of the AV node are of clinical importance. The problem is to recover them from the interbeat intervals alone, which can be easily measured from a surface electrocardiogram (ECG) without having to implant electrodes for measurement of atrial excitations. Since these parameters may change over time, it is important to be able to detect non-stationarities of the signal.

2. **Research Activities:**

Electrocardiogram recordings of patients with atrial fibrillation (AF) were processed to extract the interbeat intervals. These time series were then analyzed with various methods including a newly developed method for estimating local Hoelder exponents, which is independent of local trends (Z.R.Struzik, to be published). These exponents locally quantify the fluctuations and correlations of the signal and can detect non-stationarities. It was found that the degree of correlation is much reduced compared to healthy patients but remains above noise level most of the time.

A simple phenomenological model for generating heartbeat intervals for the condition of AF was implemented and the output compared to measured time series. Parameters of the model were adjusted to minimize the differences to a sample of measured data. The model reproduces major features of the signal well, including complex measures like the spectrum of local Hoelder exponents.

3. **Perspective of Research after this Program:**

Estimating model parameters for the AV node could prove to be a clinically valuable tool supplementing available information. Since the choice of the most effective medication is often difficult, methods as employed in the project could prove helpful in assessing the efficacy of medications. The methods used will be useful in further elucidating the nature of correlations in heartbeat intervals. A publication will be written to present the procedures and results.

4. **Advisor's Remarks:**

The research project was a fruitful and enjoyable collaboration with very interesting outcome, and I am impressed by the range of results obtained over such a short period. I think Stefan Heinrichs made very good use of his time here and could also satisfy his interests in Japanese culture.

RESEARCH REPORT

Name:	**Affiliation (University):**
Stefanie Kraft	Department of Medical Psychology, University Hospital Hamburg Eppendorf
Research Advisor:	**Host Institution:**
Dr. Isao Fukunishi, Dr. Kazuhiko Ikeda	Tokyo Institute of Psychiatry
Research Subject: Neuropsychological aspects of organ disfunctioning	

1. Research Description:

The prevalence of chronic organ diseases increases with a higher average age in the population. Metabolic changes due to organ dysfunctioning can lead to acute and long-term consequences for the central nervous system. Medical neuropsychology is concerned with the reciprocal relationship between the pathogenesis of chronic illness, underlying organ defects and their effects on the brain.
In terminal chronic organ diseases, organ transplantation is the only possible treatment. The development of transplantation medicine during the past years has profited by new technologies, advances in operation techniques and improved immunosuppressive regimens. The primary goal of organ transplantation must therefore be extended from the purely quantitative aspect of saving life to quality of life aspects. Despite an increased survival rate of organ recipients, the willingness to donate organs has droped in the population. The question of organ allocation therefore has become a highly problematic topic. Whereas in Germany living-related organ transplantation is usually only performed in cases where recipients would not survive waiting time for a cadaver organ, in Japan living related liver transplantation fully replaces cadaver transplantation due to the medical definition of death. The development of reliable neuropsychological measures to accompany the diagnostical process before and after organ transplantation contributes substantial information to routine procedures and laboratory parameters.

2. Research Activities:

Due to restructuring processes during the time of my stay at the Toyko Institute of Psychiatry, unfortunately it was not possible to participate in an ongoing reseach project in transplantation psychology. Instead I joined other research groups at the institute and visited several institutions and hospitals in the Tokyo area. This way I experienced different fields of medical psychology in Japan. Once a week I joined the medical staff at the Department for Psychosomatic Medicine at Nihon University Hospital. The friendly atmosphere allowed an active exchange on psychosomatic topics in Japan and Germany. I also visited Bosai hospital for patients with kidney diseases who need hemodialysis. The dependence on hemodialysis strongly reduces quality of life in patients with kidney disfunctioning and sometimes leads to the development of psychosomatic or psychiatric symptoms. Two invitations from different research groups at the Tokyo Institute of Neuroscience enabled me to gain insight into current neuroscientific research activities in Japan. At the Tokyo Institut of Psychiatry I was introduced into applying near-infrared spectroscopy. This non-invasive psychophysiological method is very interesting with respect to consecutive research projects in the field of medical psychology.

3. Perspective of Research after this Program:

The JSPS summer program offered me the possibility to experience different fields of psychological research in Japan, to gain insight into the Japanese health system and to get in contact with many researchers. After returning to Germany I will finish my PhD thesis and hopefully some of these contacts will continue over that time.

RESEARCH REPORT

Name:	Affiliation (University):
Rita Kuhlmann	Universität Bielefeld
Research Advisor:	**Host Institution:**
Prof. H. Nakajima	Tokyo Institute of Technology
Research Subject:	
New Body Technologies (Plastic Surgery and Prenatal Diagnostics)	

1. Research Description:

My sociological research in Japan was focused on the main question how the new body technologies will be used in an Asian country like Japan. In comparison to the Western societies - with their large Christian and philosophical tradition of mind-body-division – in Japan we don't find this dualistic point of view. How this difference in the cultural attitude toward the body influenced the using of the new body technologies was my first question.
How the social-structural situation in Japan will be reflecting in the consumption of these new body technologies – this was my second question. And my third question was if actually the Western media has influenced the concrete manipulation of the body into a more western style.

2. Research Activities:

During my stay at the Tokyo Institute of Technology with the great help of Professor Nakajima I did several interviews with experts. I asked Sociologists – working on the field of social structure, modernization and individualization theory – about the concrete situation in Japan now. Additional to the actual situation I did several interviews with experts of religions in Japan. Because the religion is a key for understanding the attitude and the feeling toward the body – this cultural and historical perspective was very helpful to understand the difference between the Asian and the Western image of the body. At least I make Interviews with experts - working in the field of the new body technologies – about the concrete practice.

3. Perspective of Research after this Program:

I will publish the results of my research in Japan in my dissertation thesis. I think this Western/Asian – Comparison will be a interesting extension of the my work about the worldwide using of the new body technologies today.

4. Advisor's Remarks:

Rita performed energetic research activities, and made many interviews to relevant researchers in Japan. She had a short talk on temporary research result at our department on 14 August. It was interesting for me to know that she found out that the direct impact of religion to the Japanese attitude to body technologies was limited. She pointed out the importance to see Japanese social structure. It seems very important finding of her here. I would like to suggest her to refine her basic framework, especially the term Asia. It covers at least three major religious zones: Moslem, Hindu and Buddhism cultures. Each zone should have different attitudes to body technologies.

RESEARCH REPORT

Name: Bjoern Roepke
Affiliation (University): Justus-Liebig University of Giessen, Germany (JLU)

Research Advisor: Prof. Dr. Yoshihisa Ando

Host Institution: Tokyo Metropolitan University (TMU)

Research Subject:
Environmental Science / Civil Engineering - Hydrology

1. Research Description:

Geoinformationsystem (GIS) based Decision Support Systems (DSS) to characterize the hydrological conditions (surface runoff, discharge, groundwater recharge etc.) of river catchments and assess the water quality within these catchments in regard to environmental pollutants (pesticides). Assuring availability and quality of safe drinking water in urban areas is a key issue for municipal planning authorities. The quantity of water available for consumption within one area depends on physical parameters of the respective catchment such as precipitation, soil, slope, land use etc. Water quality on the other hand depends on the socio-economic behavior of the population, such as agricultural pesticide use, industrial production, sewage systems, surface sealing to name a few. Both, physical and socio-economic parameters vary significantly from one watershed to the other leading to different regional drinking water quantities and potential contamination levels. The implementation of validated distributed hydrological and water quality models into a GIS is a promising approach to account for the spatial heterogeneity within watersheds.

2. Research Activities:

The main objective of the research activity at TMU was to test the feasibility of coupling the hydrological model "Soil Moisture Parameter Tank Model" (SMPT) of Ando et al. 1984 with the water quality model "Drainage Spraydrift and Runoff Input of Pesticides in Surface Waters" (DRIPS) of Roepke et al. 2003. SMPT was used to calculate daily discharge values providing the basis for predicted environmental concentration (PEC) calculations in DRIPS required for water quality assessment. To transfer the SMPT model from its current C++ structure to run in a GIS-shell as in DRIPS, a number of model parameters need to be converted to digital raster or vector maps. Digitization for a selected watershed has yet to be completed to run the model in a GIS. The initial goal of running the two models in the same GIS shell was found feasible, but requires longer research activity.

3. Perspective of Research after this Program:

Further research is required in data preprocessing and source code implementation to combine the two model approaches. In future activities, a common generic model shell including a graphical user interface for both model approaches could be made available for use in either Japan or Germany. In a joint research activity the combined model approach could be tested on datasets of the German Dill watershed and the Kota-River. The JSPS summer program provided a very valuable basis for scientific networking between Japanese and German scientists. Challenging discussions within the laboratory as well as after scientific presentations given at Universities (Tokyo Metropolitain daigaku, Meisei daigaku, Yamanashi daigaku) and on the annual conference of the Japan Society of Hydrology an Water Resources held in Fukuoka (joint publication of scientific paper (cf. appendix) were very stimulus for future collaborative research activities.

4. Advisor's Remarks:

Mr. Bjoern Roepke presented a paper at the 2003 Annual Conference of the Japan Society Hydrology and Water Resources. He developed a decision support system estimating the availability and quality of drinking water in its regional distribution. Furthermore, he presented his research work in the Dept. of Civil Engineering, Tokyo Metropolitan University. He discussed in our laboratory how to use GIS (Geographical Information System). It was a pleasure to have him in our laboratory this summer.

GIS based water quality assessment of non-point source pollutants in German river basins

Bjoern Roepke, Martin Bach, Hans-Georg Frede
Institute of Landscape Ecology & Resources Management (ILR), University of Giessen, GERMANY
bjoern.roepke@agrar.uni-giessen.de

Yosihisa Ando
Department of Civil Engineering, Faculty of Eng., Tokyo Metropolitan University, JAPAN

1. Introduction

To assure the quality of surface water-bodies in integrated catchment management, the input and fate of agriculturally used plant protection products are essential factors to take into consideration. In the context of authorizing pesticides by governmental bodies within the European Union, modeling their environmental fate grew to be the focus of research activity being a rather inexpensive and effective alternative to monitoring campaigns. User-friendly Decision Support Systems (DSS) offer decision makers easy access to these models generally providing powerful tools for regional risk-assessment.

2. Method

DRIPS (**D**rainage **R**unoff **I**nput of **P**esticides in **S**urface Water), a GIS-DSS based on model algorithms describing the major pathways of pesticide entry into surface waters, was developed on behalf of the German Federal Environmental Agency (Umweltbundesamt, UBA). The tool estimates the quantity of pesticide input from non-point sources via surface runoff, tile drainage and spraydrift (Fig. 1). Furthermore, the resulting predicted environmental concentration (PEC **s**urface **w**ater) of active ingredients (a.i.) can be retrieved considering the mean daily input of an a.i. into various types of river-basins characterized by their daily discharge (cf. Röpke, 2001).

Runoff

The amount of a substance to be dislocated by surface runoff water essentially depends on the period of time elapsed between pesticide application and actual occurrence of a runoff-producing rainfall event (Mills and Leonard, 1984). To quantify the fraction of the applied chemical in the runoff water (i) the threshold level of the rainstorm causing surface runoff, (ii) the probability of its occurrence, (iii) the volume of surface runoff as well as (iv) the concentration of the active substance in the runoff water has to be determined.

Leaching

Germany's registration authorities make use of the model PELMO by Klein et al. (1997) for assessing the risk of a.i. displacement via leaching. To conform to registration standards, PELMO was adopted in DRIPS as the model of choice to estimate the quantity of pesticides transported by leaching water. PELMO is used to simulate the displacement of an a.i. to 0.8 m depth. At that depth, the leachate is expected to enter a tile drainage system - if installed on the land – or be subject to further vertical translocation.

Drift

Surface water input of a sprayed pesticide via direct drift, is expected for the fraction of the substance, which is not reaching the target area but is directly blown into an adjacent stream. Generally, pesticide loss by drift is significantly higher for fruit- or grapevine plantations than for field crops. DRIPS uses the drift tables published by Germany's Federal Biological Research Center for Agriculture and Forestry (BBA) as a basis for estimating the fraction of a substance displaced by spray drift.

PEC

The basis for PECsw calculation are the expected mean daily inputs (E) of runoff, drainage and drift of an a.i. within these catchments estimated by the previously discussed pathways of entry. The ratio of the mean daily input into various types of surface water bodies characterized by their daily discharge (Q) yields the predicted environmental concentration (PECsw) of the respective surface water body:

$$PECsw = E/Q \qquad [1]$$

GUI

A Graphical User Interface (GUI) was created to enable potential users of the DSS to interact with the model algorithms. Model parameters like dose rate, DT50, Koc of a.i., date of pesticides application et cetera can be modified by the user in order to generate customized scenarios for a choice of 11 field crops, orchards and vineyards.

For river basin management purposes the probability of a set quantity of surface water pollution by a selected a.i. passing a defined threshold for selected months can be simulated after setting the parameters in the GUI. In order to calculate PEC spatial information, such as river-morphology, land-use, soil, precipitation et cetera is associated with the estimated input via the known pathways of entry.

3. Results and Discussion

Daily catchment specific PEC were calculated for the 60 most commonly applied a.i. for approximately 400 catchments (Fig. 2) covering the territory of Germany. The probability of a certain concentration level to be reached was also determined for all a.i. in every catchment. With DRIPS, decision makers are provided with a probability based risk assessment DSS for predicting regionally differentiated pesticide contamination of surface water on a catchment scale featuring a spatial resolution of $1km^{(2)}$ per pixel.

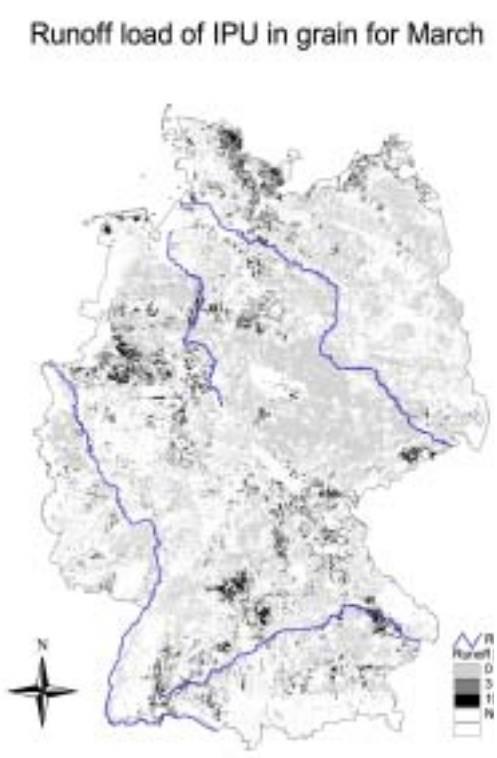


Fig. 1 DRIPS Result map: runoff load of IPU in grain for March

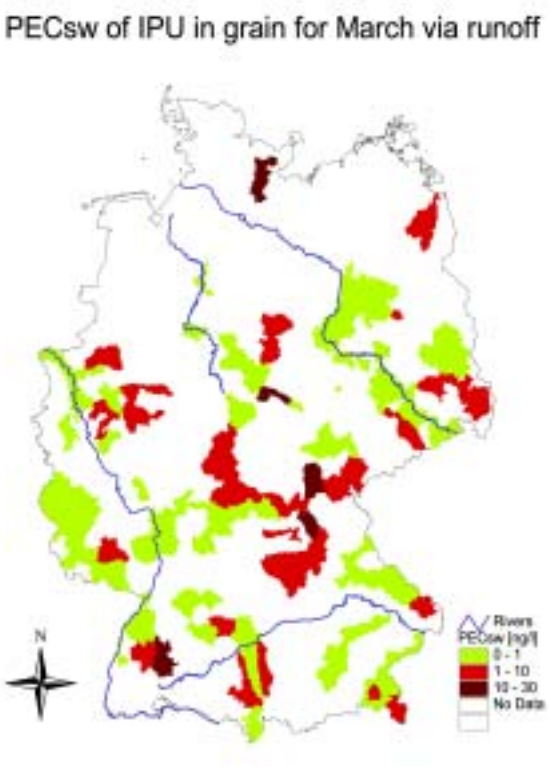


Fig. 2 DRIPS Result map: PEC_{sw} of IPU in grain for March via runoff for selected catchments

Reference

Klein M., Müller M., Dust M., Görlitz G., Gottesbüren B., Hassink J., Kloskowski R., Kubiak R., Resseler H., Schäfer H., Stein B., Vereecken H (1997). Validation of the Pesticide Leaching Model PELMO Using Lysimeter Studies Performed for Registration. Chemosphere 35(11): 2563-2587

Mills W. C., Leonard R. A. (1984). Pesticide Pollution Probabilities. Trans. ASAE 27: 1704-1710

Röpke B, Bach M, Frede H-G, 2002. DRIPS – A DSS estimating the input quantity of pesticides for German river basins. In: (Eds. Rizolli A E, Jakeman A J) Integrated Assessment and Decision Support prec of the first biennial meeting of the International Environmental Modelling and Software Society, Lugano, Switzerland, vol 1, pp 150-155.

Keywords

Water quality, river basin, diffuse pollution, GIS, PEC

RESEARCH REPORT

Name:	**Affiliation（University）:**
Florian Wenck	TU Hamburg-Harburg, Germany
Research Advisor:	**Host Institution:**
Prof.Norihisa Komoda	Osaka University, Department of Multimedia Engineering
Research Subject: About Using Supervisory Control Theory in Logistical Fields and Supply Chain Management	

1．Research Description:

The Laboratory of Prof. Komoda deals among other things with the modeling and simulation of supply chain networks. The research area I am assigned to models and supervises discrete event-driven manufacturing networks by using Supervisory Control Theory (SCT) and it's underlying modeling methodology based on the theory of languages and finite state automata (FSA). The structure of supply chain networks and it's treatment as discrete event systems (DES) leads to a need for comparison of both system classes which are located in different branches of study. Therefore in the attached article several similarities and varieties have emerged. In addition to this some difficulties of using Supervisory Control Theory in logistics becomes apparent. For a detailed description please refer to the attached article.

2．Research Activities:

- Become familiar with the research activities of Komoda Laboratory
- Presentation of my home research area
- Paper works in studying supply chain management in general, focused on enterprise modeling
- Going into details regarding the modeling and simulation of supply chains performed by Komoda Laboratory inclusive the related software product
- Understanding of how to include Supervisory Control Theory in the fields of logistics and supply chain management (for details, please see attached article)
- Meetings with DES researchers Prof. T. Ushio, Dr. Miyamoto (Osaka Univ.) and Prof. S. Takai (Wakayama Univ.) to exchange experiences about our research projects

3．Perspective of Research after this Program:

In my primary home research the Supervisory Control Theory and the underlying modeling methodology of finite state automata are used to represent and supervise discrete event-driven manufacturing systems. To serve the controller design procedure with necessary information we use for instance a hardware simulation of a bottling plant as a test environment for our research. The idea is to use the data of a supply chain network as information for the controller design procedure to extend the use of the theory onto other fields of research. After my work in Japan I can now evaluate on witch level this idea can be realized. This work acts as an initiation for further activities and helps me to integrate them into my Ph.D. thesis.

4．Advisor's Remarks:

The stay of Mr. Wenck in my laboratory was very valuable for both sides. Even though the time was very short Mr. Wenck finished almost all tasks he took into account for his stay in Japan. Besides the work on his topic he met other Japanese researchers to discuss and exchange research experiences about discrete event systems and he became familiar with Japanese culture by visiting several festivals and cultural areas. On the other hand he gave our laboratory members the possibility to learn more about research and culture in Germany. I believe this work will be a trigger for further research activities in that area.

About Using Supervisory Control Theory in Logistical Fields and Supply Chain Management

Florian Wenck

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Abstract

To increase or retain business goals of complex networks in logistical fields supervision and control of these networks is mandatory. This article deals with the adoption and evaluation of the Supervisory Control Theory on problems related to this area.

1. Introduction

In the real world companies usually do not act as independent islands equipped with all needed raw materials and components to produce their final products and with a direct connection to the desired consumer market. Namely a company is a part of a complex facility network containing a large number of other companies acting as suppliers, distributors or service bureaus.

This network connection leads to heavy interactions between the companies, thus changes in one company can influence the others (cf. fig. 1). However, for cost minimization and customers satisfaction these complex networks, titled by the term *supply chains* (SC), need a kind of control action to reach or to keep the overall objective of an optimal SC.

Therefore several methodologies for modeling, managing, supervising and optimizing of supply chains (combined in the term *supply chain management*, SCM) have been developed and, because of the increasing relevance to perform control actions on SC, several branches of business science are dealing with this (e.g. logistical management or operations research, OR) [1]. Diverse software tools are available to support companies modeling experts, process optimizers and process manager in modeling, analyzing, diagnosing and simulating of it's enterprise. Table 1 shows an assortment of software tools and associated approaches [2].

Tool	**Approach/ Architecture**
AI0 WIN	IDEF0 derived from SADT
ARIS, ARIS for R/3	ARIS
ExSpect	High-level Petri Nets
IMAGIM	GRAI/GIM, IDEF0
METIS	Object-Oriented Approach
PACE	Extended Petri Nets
QUEST	Process Flow Diagram

Table 1: Tools for enterprise modeling, analysis, and simulation (functionality varies)

The main objective of these tools focuses on the company itself. The observance of interconnections between several companies in a facility network is not a primary functionality. Therefore a wide range of non-profit tools for observing the whole structure of a facility network have been evolved from academic research. The Multi-functional Modeling Method, developed in the Department of Multimedia Engineering at Osaka University [3], and the associated software tool is one of these not-profit examples to model and simulate supply chains [4]. This new modeling methodology focuses especially on the structure of

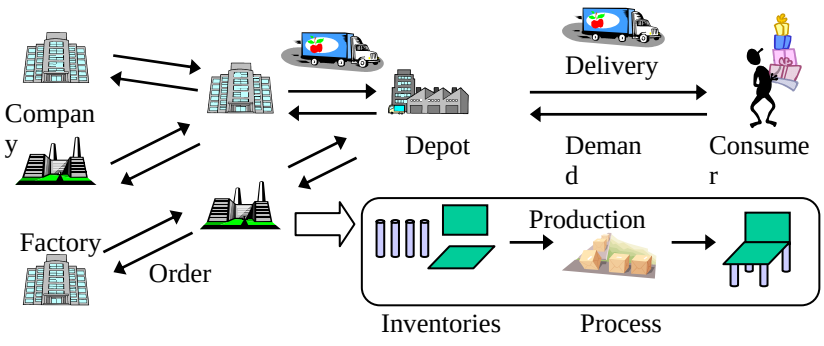

Fig. 1: An outline of a SC

the SC and leads to a more efficient way of reflecting the behavior of a supply chain on the whole.

In the field of factory automation resources and their connection to work cells or production lines are closed to the structure of SC described above but common modeling and control methodologies sometimes differ to the above mentioned techniques despite the fact both structures are considered as distributed *discrete event systems* (DES). In such systems the state transition mechanism is event driven, namely a change of the system state can only be caused by the asynchronous occurrence of an event. The trigger of this event can be located in the observed system itself or the occurrence is caused by an other system in the network. This reflects the influences between each participating system in the network. The *Supervisory Control Theory* (SCT) is one possibility to deal with modeling and supervision of DES. This control-theoretical approach elaborated by P.J. Ramadge and W.M. Wonham in the late 80th [5] is nowadays an expanded theory regarding various DES control specific situations [6].

Compared to e.g. Petri Nets, used in SCM as well as in automation, the SCT and the enclosed modeling methodology has not been applied very often to SCM problems. It can be shown, that the mapping of the SCT on SCM specific problems is a useful addition for understanding and controlling the behavior of SC.

2. Preliminaries: The SCT

This section contains a short description about the concept of the SCT and the underlying DES modeling method based on the *theory of languages* and *finite state automata* (FSA).

Consider σ as an event and Σ as a finite set of events. An arbitrarily concatenation of events $\in \Sigma$ is a sequence of events (SoE) s. The asterisk operator describes the Kleene-Closure Σ^* of Σ containing all formable SoE (and the empty SoE ε). A formal language over Σ is any subset $L \subseteq \Sigma^*$. A DES can be seen as a device generating SoE by an internal mechanism, a typical event generated by a DES in manufacturing is the activation of a sensor. The behavior of a DES G can be represented by two languages L(G) and $L_m(G)$ where L(G) contains all possible SoE can be generated by G and $L_m(G) \subseteq$ L(G) contains only marked SoE that have some special significance. For further discussion a more convenient representation of a DES is needed.

A deterministic FSA is formally defined by a five-tuple $G=(Y,\Sigma,\eta,y_0,Y_m)$ where Y is the set of states, Σ as before, $y_0 \in Y$ is the initial state, $Y_m \in Y$ is the subset of marker states and $\eta: Y \times \Sigma \rightarrow Y$ is the partial transition function. A DES is modeled as a FSA, generating the closed behavior of the system $L(G)=\{s \in \Sigma^* | \eta(y_o,s)!\}$ and the marked behavior $L_m(G)=\{s \in L(G) | \eta(y_o,s) \in Y_m\}$ by its state changes. $\eta(y_o,s)!$ by means of $\eta(y_o,s)$ is defined.

To perform a modular modeling approach, several DES can be composed by the synchronous product operation (parallel composition) ||, thus the overall system automata model is defined by

$$G = \|_i G_i$$

In many systems to be modeled the occurrence of some events can not be prevented by an external agent, thus these events are uncontrollable events. This leads to the following partition of Σ. $\Sigma=\Sigma_u \cup \Sigma_c$ by means of Σ_u is the set of uncontrollable events, Σ_c the set of controllable events respectively.

Consider $\{L(G), L_m(G)\}$ as the uncontrolled and $\{L(S/G), L_m(S/G)\}$ as the desired controlled behavior of a system (S/G: namely G under supervision of S). Proper control actions are needed, if the uncontrolled behavior violates the desired controlled behavior, i.e. $\{L(G), L_m(G)\}$ contains undesired SoE to be modified. A proper supervisor S to reach the desired behavior can be synthesized automatically using SCT. In a closed-loop connection (cf. fig. 2) S supervises the SoE s generated by G so far and disables those possible subsequent events which are undesired in the next step, using its control actions S(s) always under the constraint of uncontrollable events (cannot be disabled by S, partial observation problems are not mentioned yet but are covered by SCT). The result of this synthesis (on condition that the controllability theorem is satisfied) is a FSA representing the supervisor defined by $S=\{X,\Sigma,\zeta,x_0,X\}$ [7] where ζ is the partial transition function and $x_0 \in X$ is the initial state. Note that $X_m=X$ (all states are marker states) leads to $L(S)=L_m(S)$ and the choice of using the identical event set Σ as in G causes a total synchronization of events in the synchronized product operation. What the above means is that the behavior of the synchronized product of G and S results in the desired behavior $\{L(S/G), L_m(S/G)\}$ and the control problem is fully solved.

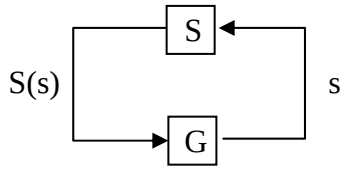

Fig 2: Closed loop structure

This standard realization of a supervisor for a DES is limited on synthesizing only interlock-controls (permissive control, alarm handling), because time is not an included modeling issue. The supervisor merely prevent undesired states and undesired sequences of states of the system by permitting and prohibiting events time-independent. To expand this framework to other subclasses of controllers (e.g. sequence or coordination controls) time has to be part of the underlying modeling methodology.

	factory automation	supply chain management
event σ	uncontrollable: -sensor activation -machine breakdown -transfer events controllable: -machine order release -router command -measurement value logging	uncontrollable: -customer order demand -database or production breakdown controllable: -production order release -B2B outgoing order to supplier -purchase order release -inventory strategy choice decision
sequence of events s	trace of the plant, plant history	decision flow, workflow
"plant model" G	machine elements, machines, work cells, shops, factory	server process, requisition process, purchase process
specifications	priority rules, illegal state avoidance, event alternance, state splitting necessity	policy rules, order sequencing rules and diverse other business rules
automata states	system state	process step
{L(S/G),L_m(S/G)}	behaviour of the controlled plant complying with the specifications	set of business scenarios complying with the specifications

Table 2: An assortment of different interpretations of modelling elements

Therefore subsequent works dealt with timed representations of DES like timed automata or stochastic approaches and the corresponding supervisory controller synthesis.

3. Using SCT in SCM

In automation the modeled plant serves the controller design procedure by SCT as an "event generator", which generates sequences of events by state changes. Modeling a supply chain in the discussed DES way means therefore to describe the chain as a proper event generator. Compared to e.g. the modeling method in [3] this can only cover a part of the SC model.

In the Multi-functional Modeling Method the whole SC is represented by 5 partial models to reduce complexity of the modeling process and for enhancing the simulation process, namely bill of material, physical, information, decision making and demand model. In this enumeration only the latter four models can taken into account for modeling in SCT. The BOM-model in its nature is a static data description of the products to be produced. Automata models are dynamic models, thus only dynamic parts of a SC can be modeled (e.g. the decision, information and material flow), i.e. automata models cannot replace all other modeling methodologies but their integration into the SCM is helpful.

A major problem to model and control a SC as a whole is the inconsistent data formats in the SC provided by divers middleware applications of the contained enterprises. In [8] the authors proposed the discussed modeling and synthesis method also only as an addition to the companies own software solutions for ERP, MES and other tasks. The resulted control structure is embedded in a meta-middleware for handling business transactions across the SC [8]. The objective is to treat a SC as distributed logical agents, interacting by activating methods (functions) in other agents. Local dynamics and static data is further on managed by local middleware of each company, whereas global dynamics is managed my the meta-middleware. Therefore every agent is represented as a FSA and the specifications are formalized as automata models of business rules to satisfy the business requirements specification across the SC. Mostly events can be seen as outcomes of decisions or order triggers and the overall system state of the SC is made up of snapshots from the current process steps of its included processes.

Compared to the factory modeling idea to represent the factory itself as an automata model, where the current system state is represented by the corresponding state of the automata (system oriented), in SCM it is more convenient to reflect on the actual process or workflow step (process oriented). For example an automata state in the overall SC model can be described in a sentence like "customer service task is preparing order X, the requisition process is fixed to base stock reorder policy and the purchasing process is idle". This process oriented point of view results from the primary restrictions in the standard SC modeling methodologies regarding the modeling of the interactions mentioned before. Therefore this modeling methodology is used as an addition to bridge this gap. Table 2 summarizes several modeling elements and there different interpretations.

The appliance of the SCT controller design procedure in SCM using a plant model to describe the processes and specifications to represent required business rules results in a set {L(S/G), L_m(S/G)} of legal SoE the controlled SC generates. Every path through the associated closed-loop automata model from the initial state back to the initial state (loop) describes therefore a legal workflow. Sometimes this structure is referred with "business scenario". The behavior of the closed-

loop system remains always legal, for instance a change in strategy decided by the management will not lead to an illegal closed-loop behavior, guaranteed and automatically obtained by using SCT.

4. Conclusions

According to the extremely high complexity of the production networks and the existing, highly distinctive uncertainties, control and supervision of this networks is of extreme importance. The application of the Supervisory Control Theory on such problems in the field of logistics improves the control and supervision of the contained information flow, decision flow and flow of materials. As an addition to existing approaches the SCT can support the achievement of overall goals like customer fill rate. For synthesizing sequence controls to stipulate sequences of process steps in a SC an expansion from DES to TimedDES modeling in reference to SCT can be done.

The interconnection between enterprises in supply chains and other logistical networks can be modeled completely as a proper "event generator" for serving the controller design procedure by SCT with all needed information. This is not essentially the case for supervision and control of a participating enterprise, resulted by the discussed lack of representing static data structures.

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RESEARCH REPORT

Name:	Affiliation (University):
Andreas Weng	J.W. Goethe Universität, Frankfurt
Research Advisor:	**Host Institution:**
Prof. Hironori Shiga	Chiba University
Research Subject:	Mathematics: Dessins d'Enfants

1. Research Description:

The theory of Dessins d'Enfants developed by A. Grothendieck links a certain combinatorial description of topological coverings of the 2-dimensional shpere without three points to the absolut Galois group. The basic ingrediant is the theorem of Belyi:
A Riemann surface is defined over a number field if and only if it is a covering of the sphere ramified at no more than three points.
I am looking for a generalization of this theory to complex dimension two.

2. Research Activities:

With the help of my host Prof. Shiga and his colleage Prof. Sugiyama I was able to fix some details in an alternative proof of the fact, that complex surfaces covering the 2-dimensional projective space unramified over the complement of six lines meeting at four points in general position are defined over some number field. I believe that this is the starting point for the two-dimensional case. I considered existence theorems for coverings with prescribed ramification behaviour and visited Prof. Masaaki Yoshida in Fukuoka for a discussion about existence problems and ways to describe the topological structure of a given covering.

3. Perspective of Research after this Program:

I hope to find some relevant examples highlightening the connection between dessins d'enfants and coverings of the 2-dim. Projective space with the above described ramification behaviour. In Japan I was able to gather some literature about finite coverings arising from hypergeometric differential equations. I will start working with these coverings looking for monodromy groups allowing non-conjugated generating sets corresponding to the same ramification indices. Such monodromy groups would indicate, that the moduli field of the corresponding surface is an extension of the field of rationals.

4. Advisor's Remarks:

The problem which Mr Weng is now making research is situated at the intersection of algebraic geometry (geometry of algebraic surface), number theory (the field of moduli), topology (the fundamental group) and the theory of differential equation (hypergeometric differential equation of 2 variables). And there are many recent results obtained by Japanes mathematicians (like Namba (Osaka), M. Kato (Kyushu), M. Kato (Ryukyu), Sekiguchi (Chuou Univ.) and Sasaki (Kobe) on this direction. During this JSPS Program he sudied a lot about the works of these Japanese researchers and made a big progress to visualize the structure of this famous open problem. I expect he will obtain some concrete results based on the research activity in Japan.

RESEARCH REPORT

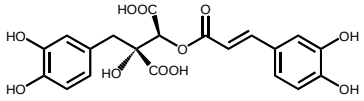
Name: Hildegard Feld
Affiliation (University): Saarland University, Germany

Research Advisor: Prof Hiroyuki Tazaki
Host Institution: Obihiro University of Agriculture and Veterinary Medicine

Research Subject:
Enzymatic studies on PAL and TAT activity in fuki (*Petasites japonicus)*

1. Research Description.

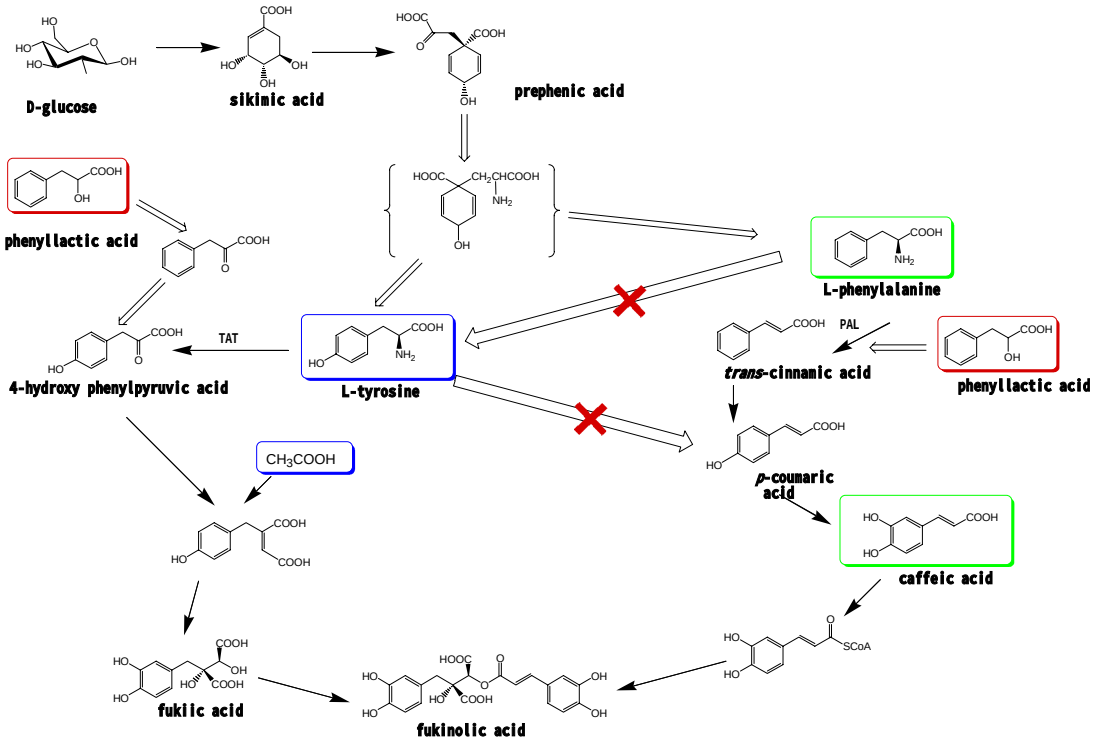
One of the major polyphenols from the Japanese vegetable fuki *(Petasites japonicus)* is the unusual phenolic compound fukinolic acid, an ester of caffeic acid and fukiic acid. It shows several biological activities like e.g. estrogenic activity and effects on collagenolytic activity.



Fukinolic acid

Feeding experiments to examine the incorporation of ^{13}C-labeled compounds into fukinolic acid of *in vitro* cultured *P. japonicus* led to a proposed biosynthetic pathway in which the enzymes phenylalanine ammonialyase (PAL) and tyrosine aminotransferase (TAT) have important functions. PAL catalyses the reaction of L-phenylalanine to cinnamic acid which is then hydroxylated twice to give the caffeic acid moiety of the molecule. TAT catalyzes the reaction of L-tyrosine and α-ketoglutaric acid to 4-hydroxypyruvic acid and L-glutamic acid; 4-hydroxypyruvic acid is further metabolised in the pathway to give the fukiic acid moiety of fukinolic acid.

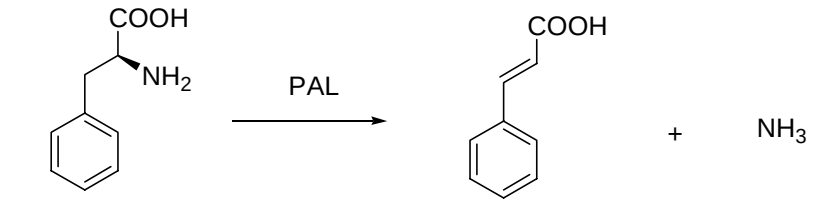
Proposed biosynthetic pathway of fukinolic acid



2. Research Activities:

Enzyme assays to determine the activity of PAL and TAT were established.

2.1 Standard procedure for PAL

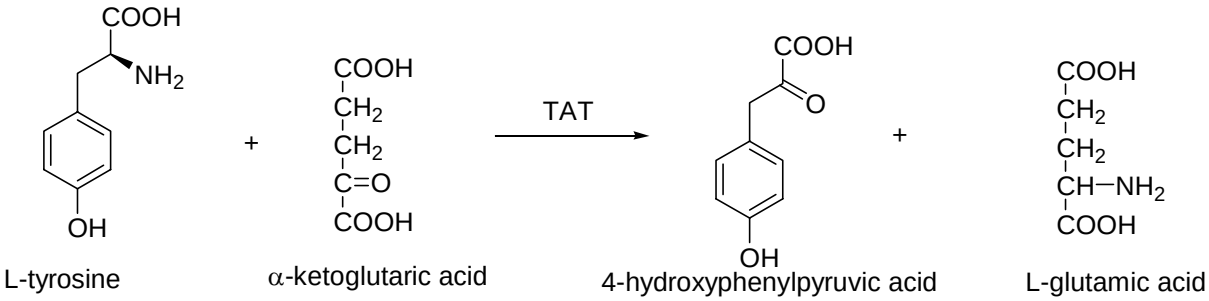


L-phenylalanine cinnamic acid

- Collection of plant tissue (one *in vitro* cultured plant, ~ 0.8 g)
- Extraction: plant tissue is milled (ultra-turax, 4°C, dial 3, 2 min) with 7.5 ml of 100mM sodium borate buffer (pH 8.8) and Polyclar VT (1.25 g) in 50 ml centrifuge tube.
- Centrifugation: at 12,000 rpm for 20 min (Kubota centrifuge, 5°C); cell-free extract is obtained.
- Incubation: 0.5 ml cell-free extract with 2mM L-phenylalanine (0.5 ml of sodium borate buffered solution, pH 8.8) in 1.5 ml micro tube at 40°C for 1 hour.
- HPLC analysis: The micro tube is centrifuged at 12,000 rpm for 5 min (Chibitan II); 10 µl of the supernatant are analysed by HPLC (Shimadzu LC-10AT VP with Shimadzu UV-VIS detector SPC-10A VP, column: Purospher Star RP18 endcapped); detection at 254 nm (cinnamic acid), flow rate 1ml/min, column temperature at 30°C.
- Gradient conditions:
  solvent A: H_20, 0.1 % HCOOH; solvent B: MeCN, 0.1 % HCOOH; linear gradient

Time (min)	Solvent B (%)
0	25
15	35
25	40
30	40

2.2 Standard procedure for TAT



L-tyrosine | α-ketoglutaric acid | 4-hydroxyphenylpyruvic acid | L-glutamic acid

- Collection of plant tissue (one *in vitro* cultured plant, ~ 0.8 g)
- Extraction: Plant tissue is milled (ultra-turax 4°C, dial 3, 2 min) with 7.5 ml of 125mM KH_2PO_4 buffer containing 1mM EDTA and 1mM dithiothreitol (pH 7.6) and Polyclar VT (1.25 g) in 50 ml centrifuge tube.
- Centrifugation: at 12,000 rpm for 20 min (Kubota centrifuge, 5°C); cell-free extract is obtained.
- Incubation: 0.5 ml cell-free extract with 0.4 ml of a KH_2PO_4 buffered solution containing L-phenylalanine (7mM) and sodium diethyldithiocarbamate (DDC, 4mM), 0.01 ml of 0.5M α-ketoglutaric acid (KH_2PO_4 buffered solution) and 0.005 ml of 5mM pyridoxal-5'-phosphate (PLP, KH_2PO_4 buffered solution) in 1.5 ml micro tube at 40°C for 1 hour.
- Conversion of *p*-HPP: 70 µl of 10 N KOH are added to induce the alkali-catalyzed conversion of the reaction product *p*-hydroxyphenylpyruvic acid (*p*-HPP) to *p*-hydroxybenzaldehyde and oxalate; the mixture is incubated for 30 minutes at room temperature.
- Precipitation of tyrosine: 140 µl of 10 N HCl are added to precipitate the remaining tyrosine.
- HPLC analysis: The micro tube is centrifuged at 12,000 rpm for 5 min (Chibitan II), 10 µl of the supernatant are analysed by HPLC (Shimadzu LC-10AT VP with Shimadzu UV-VIS detector SPC-10A VP, column: Purospher Star RP18 endcapped); detection at 275 nm (*p*-hydroxybenzaldehyde), flow rate 1ml/min, column temperature at 30°C.
- Gradient conditions:
  solvent A: H_20, 0.1 % HCOOH; solvent B: MeCN, 0.1 % HCOOH; linear gradient

Time (min)	Solvent B (%)
0	25
15	35
20	35

2.3 The reaction rate of PAL and TAT

As a result of the PAL and TAT assays the activity of both enzymes could be determined. To calculate this activity it was also necessary to determine the total protein concentration of the cellfree extract. Therefore the Bradford protein assay was carried out. We found that in the case of PAL the reaction rate was 16.01 nmol/h/µg protein whereas the reaction rate of TAT was 22.85 nmol/h/µg protein.

2.4 Influence of buffers on PAL and TAT activity

The influence of different buffers on PAL and TAT activity was examined using the described methods. One plant was divided into two equal parts and was soaked over night either in phosphate buffer (100mM, pH 5.8) or in acetate buffer (100mM, pH 5.8). After 12 hours the buffer was removed, the plant tissue was washed with distilled water and either the PAL or the TAT assay was carried out. It was found that treatment with phosphate buffer increased the activity of both enzymes compared to the acetate buffer. First 2D electrophoresis experiments to determine the differences in the protein patterns of the cellfree extracts of the phosphate and acetate incubated plant material were started also but could not be finished anymore due to the short period of time.

3. Perspective of Research after this Program:

During my stay here I was able to gain experience in the field of plant biosynthesis and enzymatic studies which was a great opportunity for me to work in a different, but related branch of my own research field, natural product chemistry. I also have developed important relationships for future cooperations and shall continue communication with my host laboratory.

4. Advisor's Remarks:

In spite of unfamiliar techniques for her, she showed good performance on the research subject of enzymatic study. Especially, she contributed confirmation of the experimental reproducibility of enzymatic activity in Fuki plant, and established the standard procedure for the PAL and TAT test in our lab. Furthermore, she exerted a good influence on Japanese students not only in the point of the research but also association. Thus, I think that she did the best work in this short period.

RESEARCH REPORT

Name: **Stefan Hoffmann**	**Affiliation (University):** **Ruhr-Universität Bochum**
Research Advisor: **Dr. SAITO Shingo**	**Host Institution:** **Kansai Advanced Research Center, CRL**
Research Subject: **Continuous THz-Generation using Semiconductor Lasers**	

1. Research Description:

Electromagnetic radiation in the so called Terahertz (THz) gap (Frequencies between 100 GHz and 10 THz) is located in the electromagnetic spectrum between microwave frequencies and infrared light. Frequencies in the THz-Regime have traditionally been difficult to generate and to detect. There are lots of applications which demand a cheap and compact THz source, like telecommunication, spectroscopy, medical examinations and treatment, chip packaging and DNA analysis. Existing systems are far to expansive and bulky to be used in everyday life. I am concentrating on using semiconductor lasers, similar to the devices used in laser pointers and CD-players to generate THz-Radiation.

2. Research Activities:

During the JSPS Summer Program I compared different ways of THz generation by photomixing in different nonlinear media. I also compared the signal to noise ratio in a range of different Bolometer-based detectctors. It was a great opportunity for me to use the well equipped laboratories here at the Kansai Advanced Research Center. Different kinds of samples and Detectors were directly available to be used. I also enjoyed the very fruitful discussions in the institute. I really could benefit from the vast knowledge about the physics of THz radiation at KARC.

3. Perspective of Research after this Program:

I really enjoyed working in Japan and I would like to continue this good cooperation in future. Some nice data have been measured, but the signal to noise ratio has to be improved in my future work. All in all I made the experience that people doing physics are pretty much the same all over the world. I never had the feeling that there is a “cultural barrier” of any kind. But before may next stay in Japan I have to improve my knowledge of Japanese. I really would like to read the menu in a Japanese restaurant.

4. Advisor's Remarks:

Staying by this program, Mr. Hoffmann performed the THz radiation experiments at our institute. He worked very hard, and obtained some fruitful results which will be published as a collaboration work between Germany and Japan. His deep knowledge and experimental skill for experiment gave good influences to Japanese students. We will have a good collaboration with each other for research.

RESEARCH REPORT

Name:	**Affiliation (University):**
Christoph Bonauer	University of Regensburg, Germany
Research Advisor:	**Host Institution:**
Prof. Dr. Seiji Shinkai	Kyushu University, Fukuoka
Research Subject:	
Synthesis of an Allosteric Receptor for Diamines	

1. Research Description:

Allosteric binding is a nonlinear process where the initial complexation of a guest species is different to the subsequent enzyme-substrate or host-guest interactions. Allosteric complexation could be also used to describe "digital" behaviors in the world of molecules, because, ultimately, their behaviors may be switched "on" or "off" only at the specific threshold conditions regulated by, for example, the effector concentration. The biomimetic design of such allosteric contrivance must be very dynamic, like "molecular machines" and is of great significance in regulating the complexation ability or the catalytic activity of artificial receptors according to the nonlinear dependence.

Basically, the allosteric systems are classified into four different categories: (a) negative heterotropic, (b) positive heterotropic, (c) negative homotropic, and (d) positive homotropic. Homotropic allosterism, which is important for the efficient regulation of equilibria and catalyses, however, is considerably very difficult to achieve in artificial systems, because of the obligatory difference in the initial and subsequent interactions. Inevitably, therefor, the system must have dynamic multipoint binding sites. It is clear, however, that positive homotropic allosterism is very useful in amplifying and converting chemical or physical signals into other signals which are convenient for us to read and record.

2. Research Activities.

Consequently, this concept can be applied to sensing a trace amount of biologically important species such as diamines. Thus the aim for the project is to synthesise a diamine-receptor in consideration of two basic requirements: (i) the receptor must posses high association constants and (ii) because these species are also present in normal tissues and sera, the receptors function must change from an "off" state to an "on" state above critical concentrations.

High association constants for diamines are achieved by receptors containing two porphyrines with a corresponding distance to the diamine-structure. In a polymer as shown in figure 1, the porphyrines can rotate around the polymer backbone. With two porphyrines in the right conformation due to the first binding event (step 1, figure 1), it should be more favoured for the other porphyrines to possess the correlating conformations and thus the binding of more diamines should take place immediately (step 2, figure 1).

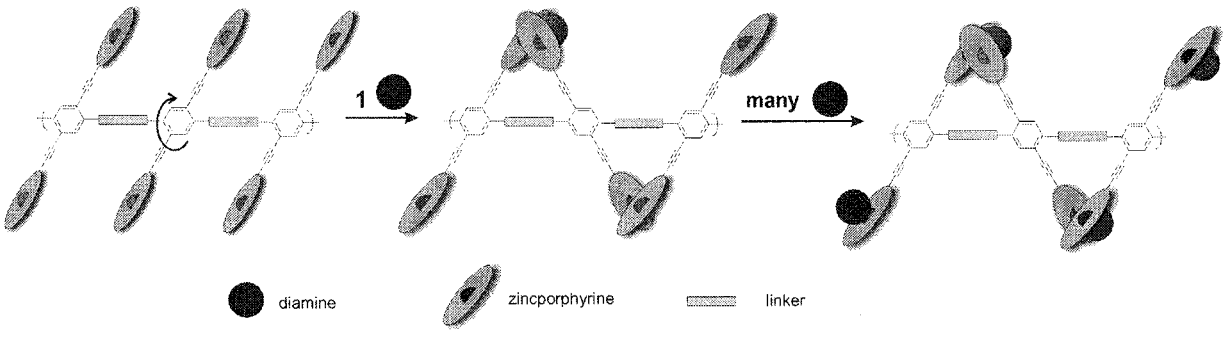
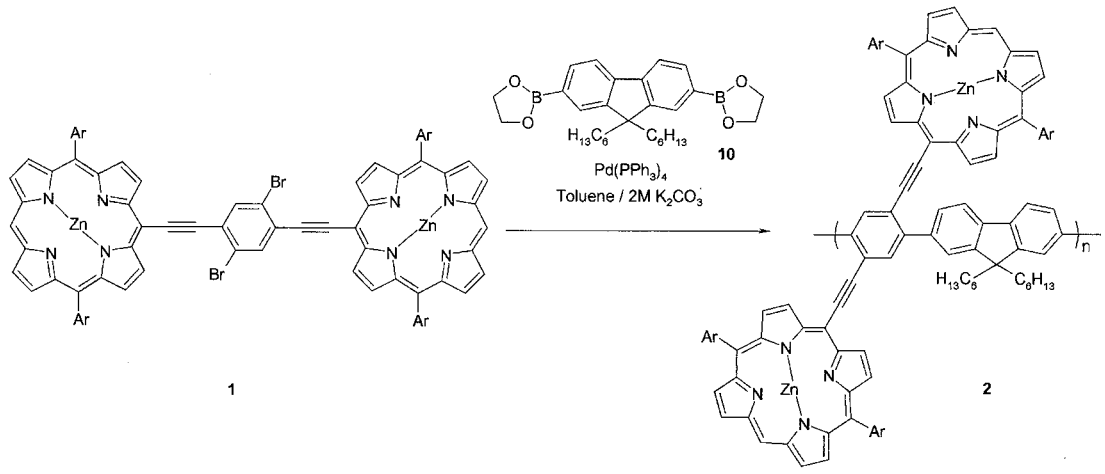


Figure 1: Allosteric binding process of a diamine to a polymer of bis-zincporphyrino building blocks.



Scheme 1: Last step of the synthesis of the receptor-polymer

The synthesis starts with acetylenisation of dibromodiiodobenzene in a Sonogashira reaction. In a second fast Sonogashira reaction it can be coupled with a monobromozincporphyrine-derivative to the desired bis-zincporphyrine building block **1**. In the following Suzuki coupling reaction the polymer **2** is made.

3. Perspective of Research after this Program:

This program was an excellent introduction to doing research in Japan. I enjoyed a productive relationship with my research advisor Prof. Shinkai, his assistants and the research group. Although this research does not exactly coincide with my dissertation research, I was able to gain a new perspective on my research, learn new laboratory techniques and observe the Japanese laboratory culture. Working with Prof. Shinkai was a great honor, as he has done important and well known work in the field.

I would like to thank the JSPS for allowing me to participate in this program. In addition, I would like to extend my sincere appreciation to Prof. Shinkai, Dr. Takeuchi and all the members in the group for all their help, guidance and hospitality during my stay.

4. Advisor's Remarks:

The allosteric effect is one of the most essential dynamic functions necessitated by living organisms. To exploit the mimics in an artificial system is, therefore, very significant. So far, there are a few examples in the low molecular-weight compounds, but no precedent for the polymeric compound exists which should show the higher allosteric efficiency. Mr. Christoph Bonauer designed and synthesized such a compound on the basis of his mechanistic insight and broad synthetic knowledge. It is really impressing that he nearly synthesized the target polymer (**2**) in spite of the short stay period in Japan. I believe that this time, the collaboration between Mr. Bonauer and our group worked very efficiently and very productively.

RESEARCH REPORT

Name: **Winfried Schepers**	**Affiliation (University):** **Technische Universität Berlin**
Research Advisor: **Professor Tadanobu Sato**	**Host Institution:** **Disaster Prevention Research Institute, Kyoto University**
Research Subject: Numerical Simulation of Standard Penetration Tests and Similar Tests for in-situ soil investigations	

1. **Research Description:**

Standard Penetration Tests (SPT) and similar tests are used to determine soil conditions in-situ. In Germany, a similar test is mostly used in practice, called Dynamic Probing (DP), which is scarcely used outside. In both tests the resistance of soil to penetration is measured by counting the number of blows for penetrating a cone into the soil by a specific length. These numbers are correlated to soil properties like relative density, bearing capacity, and shear wave velocity. The correlations between soil properties and blow counts are derived from statistical evaluations of such tests in soils with known properties and have a limited accuracy.

Furthermore, recent research result suggest a stronger dependence of tool properties on the test results than anticipated to date, particularly for the DP.

Numerical simulations of SPTs would extend the applicability to virtually all soil conditions and could increase the accuracy of the test results by considering the tools as part of the test environment.

2. **Research Activities:**

The numerical simulation of an SPT is rather complex and must be subject of a long-term research project. Professor Sato's group has an excellent reputation for the simulation of soil subjected to dynamic loads, in particular to seismic loads. On the other hand, my home university has some experience on the simulation of 3D dynamic problems due to man-made dynamic loads, in particular vibrations induced by high-speed trains. My task while in Kyoto was to get an insight in the research activities of Professor Sato's group by extensive literature studies and personal communication with the group members in order to prepare a proposal for a joint research project by Kyoto University and TU Berlin.

3. **Perspective of Research after this Program:**

After finishing the proposal it will be submitted to a appropriate foundation like JSPS or DFG. The project will be the subject of my doctoral thesis.

4. **Advisor's Remarks:**

Exchange of personnel between **Technische Universität Berlin** started from 2000. In 2001 we invited Professor Savidis, supervisor of Mr. Schepers to discuss a possibility to start cooperative research and sent Dr. Yang from our side to realize it. The dynamic behavior of saturated ground, especially liquefaction and following flow of ground, is one of major research topics in our laboratory, and the research group including Mr.Schepers in **Technische Universität Berlin** has strong background on soil-structure interaction analysis. Because of this Mr. Schepers visited our laboratory supported by JSPS summer program to seek a new research topic which should be solved by combining mutual knowledge in both laboratories. He has surveyed well our laboratory's research activities and found a new topic which will be a part of his doctoral thesis. He has developed good relationship with our laboratory's students which will contribute mutual understanding of young people between Japan and Germany.