

College of Science and Technology
Interdepartmental Seminar Series
Fall 2009

All seminars are in **Meade Hall 112**

All talks are at **3:30pm**.

Coffee and cookies will be served 30 minutes before each talk.

28 August Control of Underactuated Systems

Dr. Ho-Hoon Lee, Department of Computer Science and Industrial Technology

Abstract: In this presentation, control of underactuated systems will be discussed. The underactuated systems are dynamic systems that have more degrees of freedom than the number of actuators. Examples of these systems are industrial cranes and flexible-link robots. The control of these underactuated systems is normally complicated from the mathematical point of view since at least one actuator should control two or more degrees of freedom. For the design of control laws, the Lyapunov stability theorem is used as a mathematical tool. First, the anti-swing control of overhead cranes will be discussed, in which the design procedure, based on the Lyapunov theorem, will be briefly explained. Then the modeling and control of flexible-link robot will be presented. The results of the resulting control will be analyzed for each system.

Finally, the control of car-like four-wheeled robot will be presented. The motions of wheeled robots is subject to non-holonomic kinematic constraints. The objective is to control the x-position, y-position, heading direction, and driving speed by using only two actuators: engine torque and steering torque. In this sense, this kind of car-like robots are considered to be underactuated systems. In this talk, kinematic and dynamic modeling and related control problems will be briefly discussed. By nature, modeling and control are mathematical problems. In this talk, however, the related mathematics will be avoided, whenever possible, for general audiences.

18 September Fighting Neglected Diseases: 1,2-dihydroquinolines as potential drug candidates against African Trypanosomiasis

Dr. Jean Fotie, Department of Chemistry and Physics

Abstract: Sleeping sickness or Human African trypanosomiasis (HAT) is caused by *Trypanosoma brucei* subspecies, parasites that are transmitted by the tsetse fly. Early symptoms of HAT include malaise and irregular fevers as well as enlarged lymph glands and spleen. Parasites are later found in the central nervous system (CNS), where they cause progressive neurological disorders ending in death in the absence of chemotherapy. Approximately 17,500 annual cases of sleeping sickness were reported for the year 2004, although the disease incidence is probably three to four times higher. Pentamidine and suramin are used to treat the first phase, but do not cross the blood-brain barrier efficiently and thus are not used to treat second stage disease. Melarsoprol, an organoarsenical, is used against second stage disease but causes reactive encephalopathy in 5–10% of cases, half of which are fatal. Eflornithine is an alternative to melarsoprol treatment for second stage *T. b. gambiense* infection but is ineffective against *T. b. rhodesiense* and must be administered by slow intravenous infusion in high doses over a long course. While several other classes of molecules have displayed activity against African trypanosomes, no other drugs are approved for use against second stage disease. A safe, effective, and inexpensive replacement for melarsoprol and eflornithine against second stage HAT is desperately needed.

As part of the continuing search for novel entities with better efficacy and lower toxicity for the treatment of second stage HAT, a screening program sponsored by the World Health Organization's Special Programme for Research and Training in Tropical Diseases (WHO/TDR) was carried out at Tibotec Belgium and the Swiss Tropical Institute (STI), using compounds sourced from SPECS. This program identified a series of dihydroquinolines with promising antitrypanosomal activity, of which 1,2-dihydro-2,2,4-trimethylquinolin-6-yl 3,5-dimethoxybenzoate (TDR20364) was studied in the greatest detail. This agent displayed potent and selective antitrypanosomal activity against the *T. b. rhodesiense* strain STIB900 ($IC_{50} = 0.054 \mu M$, $SI = 300$). However, no cures were achieved and no prolongation of survival was observed in *T. b. brucei* (STIB795)-infected NMRI mice treated with TDR20364 at a daily dose of 50 mg/kg/day i.p. for four days.

As WHO/TDR scholar at The Ohio State University, I was assigned this series of compounds for medicinal chemistry optimization with parasitology support from STI. During the talk, I will be discussing the preparation, characterization and evaluation of a series of 1,2-dihydroquinoline derivatives for their antitrypanosomal activity, the *in vivo* evaluation of some of these compounds as well as a preliminary investigation of their trypanocidal mechanism of action.

30 October Chaotic behavior, probability distribution and orthogonal polynomials

Dr. Ken Li, Department of Mathematics

Abstract: In this paper we will discuss the connections among three different areas of mathematics. Various simple iterative formulas that generate chaotic behaviors will be introduced. Then we will try to obtain the probability distribution that may describe the distribution of the iterates. The orthogonal polynomials with respect to such distribution will be constructed. For example for the iterative formula $x_{n+1} = x_n^2 - 2$, $x_0 \in [-2, 2]$, we would like to go through the above investigation. Conjectures will be made and verification will be attempted.

20 November The Comparative Anatomy of Sex in Vertebrates

Dr. David Sever, Department of Biological Sciences

Abstract: The vertebrates include the jawless fish, cartilaginous fish, bony fish, amphibians, reptiles, birds and mammals. The vertebrates are not a large group (~50,000 species of which nearly 2/3s are fish) compared to the 30+ phyla of invertebrates that comprise over 98% of all multicellular animals. Still, some interesting variation occurs in vertebrate anatomy. Although a guppy may not seem to have much in common with an elephant, they share a common body plan that dates back to the first vertebrates that arose over 600 million years ago. Internal fertilization, with or without a male intromittant organ, has evolved independently in all groups except the jawless fish, and viviparity has evolved independently in all groups except jawless fish and birds. The structures associated with internal fertilization are especially variable among the major groups of vertebrates. For example, male guppies and male elephants both had intromittant organs that function to introduce sperm into the female's reproductive tract, but the organs are very different in origin and structure.