2012 Robotics Seminar (8) / Japan Council of IFToMM

Date/Time: Tuesday, December 4th, 2012, 13:30-15:00
Place: University of Tokyo, Hongo Campus,
Engineering Building #2, 3F, Room 31A
Host: Prof. Yoshihiko Nakamura (nakamura@ynl.t.u-tokyo.ac.jp)

Humanoid robotics: What we really need - just machines, or something more?

Professor Branislav Borovac
University of Novi Sad, Serbia

We are witnessing research expansion and application of robotics in almost all segments of human's activity, from industry to space exploration. Similar happen with humanoid robotics, but it has to be pointed out that its applications areas are mostly situated in environment close to humans. This imposes some specificities that have to be encountered. Two of them are, in our opinion, of essential importance. First one is that human environment is either loosely structured or completely unstructured (as a consequence, walking realization by programming it in advance is not possible and on-line generation of walk is inevitable), while second one is that robot's physical contact with surrounding objects, humans or other robots almost can not be avoided. If unexpected (and unwanted) such contact can be considered as disturbance and can jeopardize humanoid's dynamic balance, whose preservation is prerequisite for any biped activity. In both situations new approaches are needed. We have proposed new method for on-line walking generation based on set of predefined primitive movements that can be easily combined into more complex ones. Thus, basic leg's motion is always same (combined of primitives), and just parameters of primitives (step length, height of foot trajectory, leg bending intensity, walking velocity, …) have to be adjusted on-line during walking. The second issue, closely related to walking, is preservation of dynamic balance, either in static posture or during walking. Because existence of dynamic balance is assumed for any biped performing gait, its preservation is of primary importance. However, compensation strategies are not same for disturbances of various intensities. For real application this is extremely important and complex issue, particularly in case of large disturbances. Compensation action must simultaneously ensure two, often contradictory, requirements (to prevent immediate biped overturn and to bring system into state which enables previous activity to be continued when compensation action is over) and we propose compensation to be composed as synergetic action of more DOFs simultaneously.

In addition to those "engineering" research topics, robotics also open different questions, some of them belonging to ethical, moral or philosophical issues.

Relationship of humans and machines is already well established and can be summarized as follows: humans use machines as things. However, robotics is bringing in human environment new machines that imitate living beings and have additional ability - interaction. This starts to shake traditional man-machine relationship and introduce radical changes. Relationship of humans with those machines is starting to become essentially different. In human environment interaction of robots

and humans is inevitable. Generally, humans can chose (and change) the manner of interaction (by asking or not-asking humanoid to do something), but, certain categories of people would significantly ease the everyday life by using such machines extensively (aged, weak, handicapped, disabled, …). As already known, almost all of them have additional problem: loneliness, and they also need companionship. As humanoids are already present (to help them) it is expected that they will be considered suitable to take this role.

In such situation important question arise: what should be nature of human-humanoid interaction and what kind of relationship we can expect to be developed. In our opinion, humans usually expect such robot to be "dedicated" to them personally what further means that this interaction should also be "personalized" i.e. enriched by "joint experience" of user and robot. Joint experience do not consider just "remembered joint presence to same event" but also "joint memories and feelings" (identical or not) about event both parties were present. However, this is a basis for "friendship" to be developed. This is already something what today's humanoids cannot offer. This lead us to pose a basic moral and ethical question: Should machine (robot) be "company or friend?" to humans? At the moment there is no clear answer on this question. Researchers avoid this issue by pointing research goals toward physical help to people. Another aspect of same question is further development of robots. Because robots have to react and respond to actions of humans, question arise - should they imitate human behaviour (and to which extent) or an attempt have to be made, to enable humanoids to develop their own "personal" behaviour pattern on which humans have to be accustomed (please note that humans are already accustomed to behavior pattern of pets, for example, dogs and cats)? We still do not have an definite answer on this question as well as on many other related questions, like: What robot should look like (imitation of human face or not) to ensure that his appearance is pleasant and acceptable to humans?, What constitute acceptable behaviour?, How non-verbal communication should be implemented (should human-like gestures be implemented or new ones, more appropriate for robots, should be developed?), …

In this speech, mostly our ongoing research will be presented because in our current projects we cope with some of issues mentioned. We think those questions should not be avoided and have to be faced.

Biography:

Professor Branislav Borovac was born in Leskovac, Serbia, 1951. He received the M.Sc. and Ph.D. degrees in Mechanical Engineering from the University of Novi Sad in 1982 and 1986 respectively. He became Assistant Professor of Engineering Design 1987, Assistant Professor of Robotics 1988, Associate Professor of Robotics 1993 and since 1998 he has been Professor of Robotics, all at the Faculty of Technical Sciences, University of Novi Sad. He is coauthor of two research monograph and five book chapters. He is author/coauthor of over 40 scientific papers in the field of roboticspublished in international journals, as well as author/coauthor of about 90 papers in proceedings of international conferences and congresses. His citation index is over 1000. He was visiting professor at University of Versailles, 2009 and Prince of Songkla University, Hat Yai, Thailand, 2012. He is Associate editor of International Journal of Humanoid Robotics (published by World Scientific Publishing Co., Pte. Ltd. His research interest includes biped locomotion, humanoids, robot modeling and control, industrial robotics, sensors and sensor information integration, mechatronics.