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From human to humanoid locomotion

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ABSTRACT OF THE TALK

This talk reports on a pluridisciplinary research combining neuroscience and robotics:

- first to better understand the laws underlying the natural human locomotion,

- and second to provide humanoid robots with human-like behaviors.

This research is done in collaboration with LPPA (A. Berthoz) and the University of Heidelberg (K. Mombaur) as a part of the French ANR project Locanthrope.

Despite the theoretically infinite number of possible trajectories a human may take to reach a distant goal, this task is actually stereotyped: while no specific constraint is provided to subjects in terms of the path they have to follow, all of them generated very similar trajectories.

It is well known that the best way to walk is to "put a feed in front of the other one, and then to repeat". This simple statement suggests a differential coupling between body position derivative and body direction. We will see that the choice of the body frame accounting such a coupling reveals interesting properties linking the body segments (head, torso, pelvis).

The second part of the talk will be dedicated to the identification of the optimal criteria that may account for the shape of the locomotor trajectories. Thanks to an original "inverse optimal control" approach, effective solutions have been

provided. They are used to generate the locomotor trajectories of the humanoid robot HRP2.

Finally concluding remarks will tend to give sense to fuzzy questions such as: is locomotion an action as another one? and even: is locomotion an action? what is an action? Answering such questions is a challenging issue, at least in Robotics!

Jean-Paul Laumond (IEEE Fellow) is Directeur de Recherche at LAAS-CNRS in Toulouse, France. He received the M.S. degree in Mathematics, the Ph.D. in Robotics and the Habilitation from the University Paul Sabatier at Toulouse in 1976, 1984 and 1989 respectively. With his group Gepetto (www.laas.fr/gepetto) he is exploring the computational foundations of anthropomorphic motion. He has been a Coordinator for two European Esprit projects, PROMotion (1992–1995) and MOLOG (1999–2002), both dedicated to robot motion planning technology. During 2001–2002, he created and managed Kineo CAM, a spin-off company from the LAAS-CNRS to develop and market motion planning technology. From 2005 to 2008 he was a co-director of JRL, a French-Japanese CNRS-AIST laboratory dedicated to humanoid robotics. He teaches robotics at the ENSTA and Ecole Normale Superieure in Paris. He published more than 150 papers in international journals and conferences in computer science, automatic control, robotics and neurosciences. He is a member of the IEEE RAS AdCom.