PhD Proposal 2017

School: Ecole Centrale de Nantes	
Laboratory: LS2N (currently IRCCyN)	**Web site: http://www.irccyn.ec-nantes.fr/en/**
Team: REV (Robotics)	**Head of the team: D. Chablat**
Supervisor: S. Sakka, D. Chablat	**Email: sophie.sakka@ec-nantes.fr**
Collaboration with other partner during this PhD: **In France:**	**In China:**

Title: Design of a human motion capture device for ambulatory applications
Scientific field: Robotics, Mechanics
Key words: Motion capture, ambulatory, device, human motion

(Maximal length of 2 pages, including images, list of reference, ...The <u>pdf file</u> should <u>not</u> exceed 1Mo)
Background, Context:

In REV research group, we have been working a lot on the realtime imitation of human motion by a humanoid robot. Different devices were used, from complete and precise optical motion capture (infrared) to easy-to-use and approached Kinect. All the proposed systems require that the body to be imitated remains in a given area, and for lighter systems (such as Kinect), occlusion remains a problem. Another drawback of the current systems, is the need to use force-plates when dynamics measures are needed.

Research subject, work plan:

The candidate will focus on designing and validating a motion capture system for kinematics and dynamics measurements of human motion. As the system will be used to control a big size humanoid robot in realtime, it is important that the operator has a feedback of the humanoid dynamics in order to control balance of the robot. An experimental prototype is expected, with validation on the humanoid robots available in the research group: NAO (58cm, 6kg) and ROMEO (140cm, 39kg). The designed solution will have to meet requirements: precision, lightweight, autonomous and easy to use.

The Ph.D. will be organized as follows:

- **Year 1: Understanding the problems involved. 1) Bibliographic study and positioning (6 months), leading to a research report and a presentation to the research group; 2) experimental design and realization of one relevant existing device detected in the bibliography (6 months, report, presentation), development of experimental abilities.**
- **Year 2: Making research. From year 1, choose three points to be developed as research. 1) Realize point 1 (6 months) up to publication; 2) Realize points 2 and 3.**
- **Year 3: Concluding Ph.D. Publications, finish experiments, thesis writing and defence.**

References:

[1] Capturing human motion using body-fixed sensors: outdoor measurement and clinical applications. Kamiar Aminian, Bijan Najafi (2004). Computer Animation & Virtual Worlds.
[2] Human motion tracking for rehabilitation—A survey. Huiyu Zhoua, Huosheng Hu (2008). Biomedical Signal Processing and Control, Vol. **3**(1).
[3] Xsens MVN: Full 6DOF Human Motion Tracking Using Miniature Inertial Sensors. Daniel Roetenberg, Henk Luinge, Per Slycke (2013). Xsens Technologies.
[4] Accuracy of Inertial Motion Sensors in Static, Quasistatic, and Complex Dynamic Motion. Alison Godwin, Michael Agnew, Joan Stevenson (2009). J Biomech Eng, Vol. **131**(11).
[5] An in-shoe device to measure plantar pressure during daily human activity. M. Saito, K. Nakajima, C. Takano, Y. Ohta, C. Sugimoto, R. Ezoe, K. Sasaki, H. Hosaka, T. Ifukube, S. Ino, K. Yamashita (2011). Medical Engineering & Physics, Vol. **33**(5).