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Whole-Body Compliant Dynamical Contacts in Cognitive Humanoids

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Abstract	In this document we provide a comprehensive exploitation plan
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First draft	19 Feb 2014	This version mainly contains the information that was collected via email from the partners. Partners provided IIT with details on their technological transfer facilities.	Francesco Nori
Second version	25 Mar 2015	Added description of Inria partner, added to the consortium	Serena Ivaldi

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4 Exploitation of results

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1 Introduction

This deliverable presents the dissemination and exploitation plan. With respect to the plan proposed in the CoDyCo description of work, we provide additional information mainly concerning the technological transfer facilities available for partners and the possible exploitation of the project results. More details can be found in Section “B3. IMPACT” of the CoDyCo description of work, with specific attention to “B3.2 PLAN FOR THE USE AND DISSEMINATION OF FOREGROUND”. In the present deliverable no information is given about the dissemination plan and again the interested read should refer to the description of work, Section “B3.2.1 DISSEMINATION PLAN”.

2 Executive Summary

The present deliverable is organized in two sections. Section 3 presents partner by partner the available technological transfer resources. Section 4 gives a few more details on the possible exploitation areas.

3 Technological transfer facilities

In this section we describe the technological transfer facilities per each of the CoDyCo partners. We discuss in particular relevant information such as number of people involved in the facilities, a brief description of the activities and a tentative list of companies which collaborate with the institution.

3.1 The IIT technological transfer facility

3.1.1 Name of the office for tech transfer

The IIT has a Technology Transfer office directed by Salvatore Majorana: salvatore.majorana@iit.it.

3.1.2 Number of people involved in the activity

The office has two divisions, 9 people and three more will join the group from June 2014 in licensing and industrial alliances division. Current members are:

- Lorenzo De Michieli, manager of licensing and industrial liaison division: lorenzo.demichieli@iit.it
- Fulvio Puzone, business developer (licensing and industrial liaison): fulvio.puzone@iit.it
- Marcella Impoco, IP and contracts lawyer (licensing and industrial liaison): marcella.impoco@iit.it
- Federica Fordred, administration and finance: federica.fordred@iit.it

- Lorenzo Rossi, manager IP protection division: lorenzo.rossi@iit.it
- Augusta Galano, senior patent professional (IP protection): augusta.galano@iit.it
- Roberta Sulcis, senior patent professional (IP protection): roberta.sulcis@iit.it
- Matteo Faccenda, junior patent professional (IP protection): matteo.faccenda@iit.it

3.1.3 Rough estimate of the amount of projects managed by the office

- Patent cumulative portfolio: 241 (Jan 2014);
- Research contracts with Industry: 47 in 2013 (about 3M Euro);
- Licensing: patent licenses and options: 39 in 2013;
- Spin Off companies: 7 launched between 2012 and 2013 (+6 in progress);
- Projects: involvement in Graphene Flagship EU project (WP innovation).

3.1.4 Brief description of the activities of the tech transfer office

Here is a list of the activities of the IIT technological transfer office:

- protection of new technologies
- licensing
- definition and management of research contracts
- launch of start ups
- networking with companies
- networking with investors
- training

3.1.5 Initiatives of the tech transfer office: competitions, awards, etc.

- participation at talks, workshops, organizations of courses and seminars on IP protection and innovation management
- participation and organization of start up contests
- networking with investor (VC, business angels, corporate VC, etc.)
- University Master on Innovation Management jointly carried out with University of Genova.

3.1.6 List of companies which collaborate with your institution

Here is a confidential list of collaborations.

- Finmeccanica
- Roche
- Angelini
- Vibram
- Omet
- Tyrolit
- Solvay
- Enel
- Avio Aero
- Omron
- STM
- ENI
- Aviospace
- Saes Getters

3.2 The TUD technological transfer facility

3.2.1 Name of the office for tech transfer

Tech transfer services are provided by two units at TU Darmstadt:

- Tech Transfer Office (Referat VI E: Transfer), headed by Dr. Annette Miller-Suermann.
- Industry Liaison Office (Referat VI B: Kooperationen), headed by Dr.-Ing. Nicolas Repp.

3.2.2 Number of people involved in the activity

- Tech Transfer Office: 7 members of staff, including HIGEHST (Home of Innovation, Growth, Entrepreneurship and Technology Management)
- Industry Liaison Office : 5 members of staff Contact details can be found here: http://www.intern.tu-darmstadt.de/dez_vi/ansprechpartnerinnen/ansprechpartner.de.jsp

3.2.3 Rough estimate of the amount of projects managed by the office

Patents	2010	2011	2012	2013
Invention disclosures	72	87	68	73
Patent applications	33	39	45	18
Currently active property rights (national)	46	67	79	88
Currently active property rights (international)	37	43	79	94
Total amount	83	110	158	182

Spin-offs:

- From 2010 to 2012: 29 spin-offs founded.
- Since 2013: 12 spin-offs founded.
- In 2013 more than 166 prospective entrepreneurs got initial advice by the Tech Transfer Office / HIGHEST.

Examples of TU Darmstadt spin-offs can be found here: <http://www.highest.tu-darmstadt.de/highest/gruendungsbeispiele/index.de.jsp>

3.2.4 Brief description of the activities of the tech transfer office

- Tech Transfer Office: information, advice and support for the following topics: IP management, commercialization of research results, entrepreneurship (HIGHEST).
- Industry Liaison Office : information, advice and support w.r.t. industry liaison topics (e.g. matchmaking, first level contractual advice), management of private public partnerships on a strategic level, key account management for industry partners, organization of trade fair participations.

3.2.5 Initiatives of the tech transfer office

The Tech Transfer Office / HIGHEST is organizing an annual ideas competition (TU Darmstadt Ideenwettbewerb) for students as well as members of staff.

3.2.6 List of companies which collaborate with the institution

TU Darmstadt is collaborating with a wide range of companies of all sizes. On a strategic level, the following companies are strongly connected to TU Darmstadt (e.g. in form of joint research labs or strategic partnerships):

- Deutsche Bahn
- Continental
- Merck
- Intel

- SAP

Unfortunately, we cannot provide a full list of our collaborations due to nondisclosure agreements with our partners.

3.3 The UPMC technological transfer facility

3.3.1 Name of the office for tech transfer

SATT LUTECH

3.3.2 Number of people involved in the activity

Research potential: more than 7,500 FTE (Full-time equivalent) scientists and research staff. A potential equivalent to UC Berkeley, Univ. Wisconsin or UCL.

3.3.3 Brief description of the activities of the tech transfer office

About SATT LUTECH : SATT LUTECH is a privately owned company specialized in transfer and commercialization of innovative technologies. The company was created by Universit Pierre et Marie Curie, CNRS, Universit de Technologie de Compigne, Musum national dHistoire naturelle, INSEAD, Universit Panthon-Assas, Ecole Nationale Suprieure de design et de Cration Industrielle and the Caisse des Dpts group which is a "public group serving general interest and economic development". SATT LUTECH was created on January 31, 2012. Following its successful bid in the French governments Investing in the Future program, SATT LUTECH was awarded 20 million euros for its first three years of operations, and will amount 73 million euros over ten years. SATT LUTECHs role is to focus on the transfer and commercialization of technologies issued from the research laboratories of its shareholders.

SATT LUTECH covers three main activities:

- Detection of research results developed in its shareholders laboratories which could lead to commercial innovations.
- Investment in the development of research results and demonstration of their potential through pilot projects, on a scale and under conditions that will create interest of companies and / or investors.
- Commercialization of matured technologies to an existing company or through the creation of a start-up.

SATT LUTECH invests in the following areas:

- Health
- Information technology and communication
- Chemistry - Materials Processes
- Environment and Energy

3.3.4 Initiatives of the tech transfer office

Success stories in Medical/Pharmaceutical:

- HIV Detection Kit: extensive licensing, revenues currently at 800 k/year
- Collectis: publically listed, 2010 expected turnover: 24.7 M (+100%)
- CARMAT: publically listed, founded in 2008, and 40 M invested
- Supersonic Imagine: founded in 2005, 61,5 M invested
- Fovea: acquired by Sanofi for 370 M

Information Technology

- Qosmos: founded in 2000, turnover in 2010 was 9.3 Ma 40% increase from 2009, and ten times the turnover in 2005
- Sensitive Objects: acquired by Tyco in 2010 for 44 M2

3.3.5 LUTECH Research Potential

Cutting-Edge Researchers

- 5 Fields Medal laureates
- 44 European Research Council Grants
- More than 60 members of the French Academy of Science

Broad Range of Disciplines organised in 5 themes:

- Computer Science, Mathematics, Engineering
- Material Sciences
- Environment and Earth Science
- Life and Health Sciences
- Arts, Humanities, Social and Organisation Sciences

3.3.6 List of companies which collaborate with the institution

- Shareholders :
- CNRS
- INSEAD
- Universit Pierre et Marie Curie

- Universit Panthon-Assas
- Universit de Technologie de Compigne
- Caisse des Dpts et Consignations
- Museum national dHistoire naturelle
- Les Ateliers-Paris Design Institute (cole Nationale Suprieure de Cration Industrielle)

3.4 The JSI technological transfer facility

3.4.1 Name of the office for tech transfer

Center for Tehnology Transfer and Innovation, Joef Stefan Institute, Ljubljana. Head of unit: dr. pela Stres, LLM, patent attorney

3.4.2 Number of people involved in the activity

11 (dr. Spela Stres, dr. Levin Pal, dr. Marija Nika Lovin, dr. Urban Odi, mag. Robert Blatnik, mag. Marjeta Trobec, France Podobnik, Urban egedin, Alen Draganovi, Lea Kane, Miha Goriup), contact details available: <http://tehnologije.ijs.si/ttwiki/en/Workers>

3.4.3 Brief description of the activities of the tech transfer office

The Centre for technology and innovation (CTT) at the "Jozef Stefan" Institute operates as an independent centre within the Institute since 2010. The JSI is the largest Slovenian institute for research in science, engineering sciences and environmental sciences. Their mission is to connect science with the society: science with business and science with education. They assist in organizing and carrying out contract research and other collaborations with industry, licensing and spin-offing and at individual technology projects of the Institute.

3.5 The UB technological transfer facility

3.5.1 Name of the office for tech transfer

Alta Innovations Limited (<http://www.birmingham.ac.uk/generic/alta-innovations/index.aspx>) CEO: James Wilkie.

3.5.2 Number of people involved in the activity

Four people are involved in technology transfer activity within Alta Innovations. In addition each College has a Commercialisation officer, who in collaboration with Alta, assists with commercialisation of research from the College .

3.5.3 Rough estimate of the amount of projects managed by the office

Each year Alta deals with up to 140 invention disclosures, files approx.. 20 patent applications and agrees approx 15 IP licence/assignment agreements.

3.5.4 Brief description of the activities of the tech transfer office

Alta Innovations links University of Birmingham's academic research with business to generate new ideas, technologies and processes required to achieve competitive advantage. It provides expert technology transfer services to University researchers and external businesses including:

- Protection of IP generated by University research projects.
- Commercial exploitation of IP through licensing and spin-out formation
- Academic consultancy
- Management of Birmingham Research Park

3.5.5 Initiatives of the tech transfer office

Alta Innovations is part of the University's Research and Innovation Services (RIS) departments and works closely with colleagues in RIS to provide entrepreneurship seminars and training. Also hold Enterprising Birmingham competition every two years to promote business planning and entrepreneurial activity. Manage Enterprising Birmingham Fund, which provides University funds (up to a total of 200,000 pa) to support development of research outputs beyond Follow-on-Fund support to bring technology closer to market.

3.5.6 List of companies which collaborate with your institution

University of Birmingham collaborates with a huge number of companies both large and small with the list wide ranging depending on the discipline and it is difficult to give a complete list. We are the University Technology centre for Rolls Royce and have strategic partnerships with multitude of institutes including Jaguar Land Rover, Network rail, IBM, Honda Research institute, BAE, Qinetiq, Kraft etc. We are also the founding research partner for Manufacturing Technology Centre, which has 61 Industry members. Our researchers also collaborate with hundreds of other organisations like Google, HP labs, National Nuclear labs, Proctor and Gamble, National Grid etc. Details of licensees are generally confidential.

3.6 The INRIA technology transfer facility

Inria's goal is to ensure that its research has the greatest possible economic and societal impact by stimulating innovation through the transfer of its skills and technologies. Digital science and technology play a decisive role in improving society and our daily life. They have a direct and lasting influence on all sectors of industry, and keeping at the forefront of these fields is a key factor in staying competitive. Therefore, the Institute is strongly committed to working within competitiveness clusters, in order to identify demand and play an active role in the development of innovative ecosystems. Our strategic partnerships with large firms' R&D departments enable our teams to be involved in research projects on an industrial scale. One aim of such collaboration is to build long-term relationships, often in the form of Inria Joint Laboratories. At the same time, Inria also makes technology transfer a priority by helping to launch new companies and by forming partnerships with innovative SMEs. Interoperability

also contributes to societal development and growth of the digital economy, whether through standardisation or "openness". That is why reasonable support of open-source software, open access to public data, and open web standards also form part of our transfer policy.

3.6.1 Name of the office for technology transfer

The technology transfer activity at Inria is directed by Eric Horlait, Deputy CEO for Transfer and Industrial Partnerships: eric.horlait@inria.fr.

3.6.2 Number of people involved in the activity

Inria is composed of 8 Research Centers, located in different regions of France, and a headquarter located near Paris. In each Research Center, there is a local unit (named STIP: *Service for Transfer Innovation Partnerships*), involving about 2-3 persons dedicated to technology transfer and industrial partnerships. The local STIP units work in close interaction with the national transfer & partnerships team, composed of about 15 persons. This national team is based at the Inria's headquarter, and is directed by Celine Serrano.

3.6.3 Brief description of the activities of the tech transfer office

The main activities of Inrias technology transfer office are:

- Detection of transferable research results
- Intellectual property management (patents, software)
- Promotion of new technologies
- Networking with companies
- Support for startup launching
- Support for establishing research collaborations with companies
- Contract negotiation
- Launching and managing technology transfer projects
- Stimulation actions to promote Academic-Industry collaborations
- Participation to local and national organizations related to tech transfer and innovation

3.6.4 Initiatives of the tech transfer office: competitions, awards, etc.

Events

The tech transfer office organizes about 2-3 events per year, national events named *Rencontres Inria Industrie* (Inria-Industry Meetings), where Inria's technologies are presented to companies, in order to make arise new collaborations and tech transfer projects. (details: <http://www.inria.fr/en/innovation/partnerships-transfer-of-technology/inria-industry-meetings2/presentation>)

Joint labs with SMEs:

In order to boost technology transfers to SMEs and SMIs, Inria has established the Inria Innovation Lab (ex I-Labs) system. The idea is to bring together an Inria project team and a partner SME in a joint laboratory. The two entities define a joint, specific work program lasting two to three years. Incentives are given by Inria to the project team involved, while the SME can receive government assistance to finance its research project. Ultimately, the innovation capacity of these SMEs must be reinforced, with an increase in their R&D recruitments and technology transfers. (details: <http://www.inria.fr/en/innovation/inria-smes/inria-and-smes-joint-labs2/inria-innovation-labs>)

3.6.5 List of companies which collaborate with your institution

Inria's current strategic partners are:

- Alcatel-Lucent
- Alstom
- EDF
- EADS-Astrium
- Microsoft Research
- Google
- France Telecom Orange Labs
- Bull
- ST Microelectronics
- Technicolor
- Total

Inria's project teams are involved in many projects involving other major companies (Airbus, THALES, Dassault System, Snecma Safran, GE healthcare, IBM, Telefonica, etc.), and also several SMEs, including startups.

4 Exploitation of results

In this section we discuss possible industrial applications of the results achieved by the CoDyCo project. A first area of application is definitively an extension of commercial product like the Xsens MVN Motion Capture (see Fig. 1). This device is a whole-body motion tracking system similar to the well known Vicon system¹ with some specific advantages like the unlimited tracking volume. This specific device with respect to the Vicon system has the advantage

¹<http://www.vicon.com>



Figure 1: the images show the commercial product like the Xsens MVN Motion Capture. This system consists of inertial sensors attached to the body by a lycra suit. The motion capture data can be used to animate digital characters in films, games, broadcasted animated stories, ads, serious gaming, virtual environments ea. to get realistic human movement.

of accessing direct velocity and acceleration measurements which can be used to retrieve full kinematics of each body segment (position, velocity, acceleration, orientation, angular velocity and angular acceleration). Customers of this kind of devices include Sony Pictures Imageworks, Double Negative, Daimler, Electronic Arts, Industrial Light & Magic, Daimler, INAIL, Ossur and others.

Another possible area of application is the one addressed by the Bertec company, a leading industry in the field of force measurement technology for biomechanics. Fig. 2 show four possible areas of applications ranging from gait analysis, balance mobility, sports performance and ergonomics. Current available technologies are anyway limited to devices to measure the ground reaction forces exchanged between the subject / patient / athletes feet and the surface of the platform.

NexGen Ergonomics represents another successful company in the field of human whole-body motion analysis. Their activities include: 3D human modeling software, ergonomic design systems, video analysis and other job analysis systems, force measurement systems, EMG analysis systems and data acquisition systems. Here is a list of interesting NexGen Ergonomics product, pertinent to the CoDyCo scope.

- The ErgoIntelligence MMH (Manual Material Handling) modules focus on material handling applications and provide an in-depth risk analysis for low-back injury. This software allows indirect calculation of estimation of energy expenditure. The model can be used to assess whole body fatigue, identify a specific task producing excessive fatigue, or it can be used to determine work-rest ratios. Here is a list of the modules contained in the manual material handling software:
 - EI-MMH-N : NIOSH Lifting Equation with multi-task analysis
 - EI-MMH-NPRO : MMH-N with 2D biomechanics and 2D manikin facility
 - EI-MMH-SCM : Snook & Ciriello and Mital Table analysis
 - EI-MMH-SCMPRO : MMH-SCM with biomechanics
 - EI-MMH-EE : Energy Expenditure

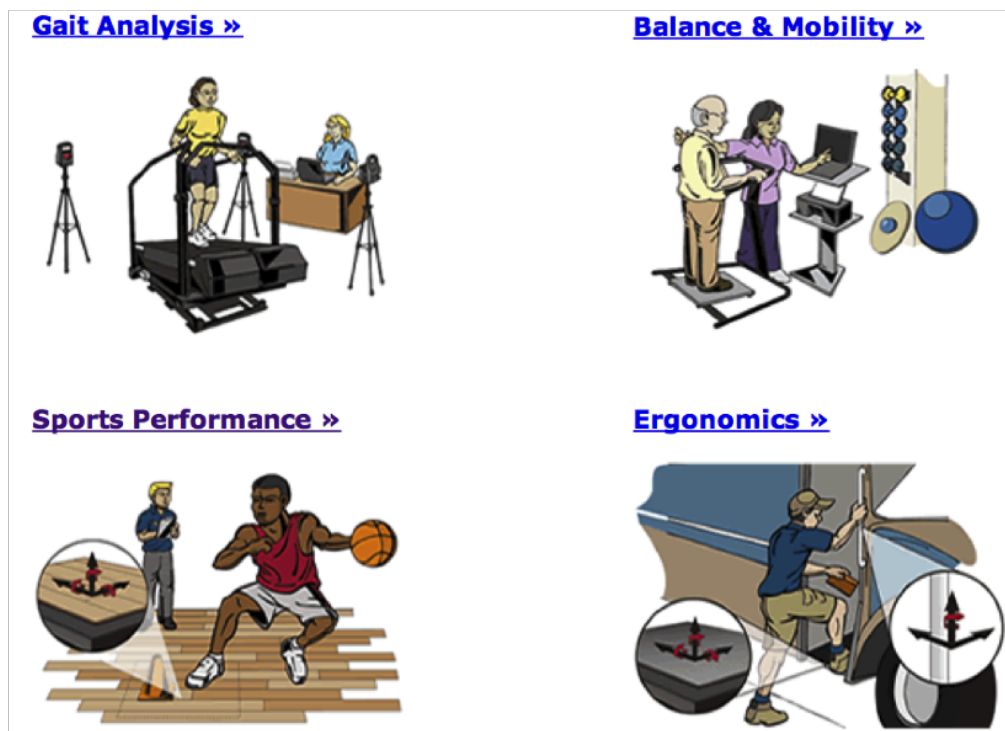


Figure 2: the images show possible applications of devices to measure whole-body interaction forces. This image has been taken from the Bertec company website <http://bertec.com>. Bertec is an international industry leader in force measurement technology for biomechanics.

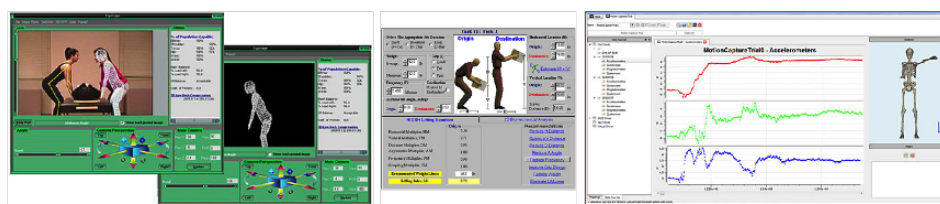


Figure 3: the images show possible applications in the field of human whole-body motion analysis. This image has been taken from the NexGen Ergonomics company website <http://www.nexgenergo.com>.

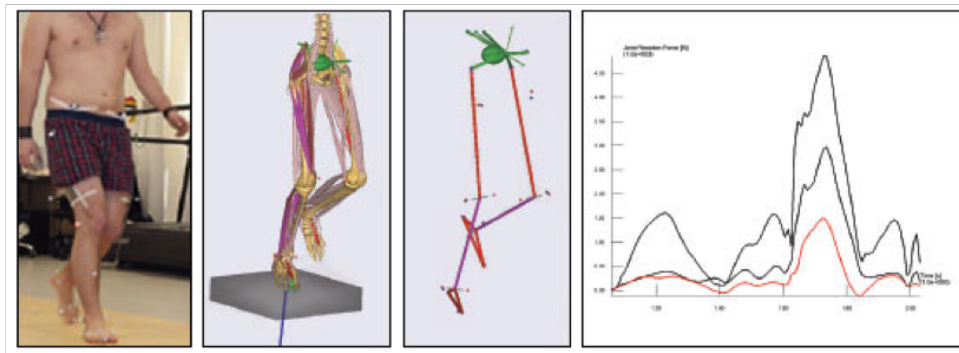


Figure 4: images of the AnyBody AnyGait software. This is a commercial product of NexGen Ergonomics to obtain sophisticated musculoskeletal analysis of trials.

All quantities are indirectly computed and, as such, not specifically tuned on the subject to be analyzed.

- The ErgoIntelligence Upper Extremity Assessment (UEA) is a similar tool focused on upper limbs.
- The AnyBody Modeling System simulates human body movements to estimate individual muscle forces, joint forces and moments, metabolism, elastic energy in tendons and antagonistic muscle actions. Movements are described specifying external forces and posture or motion for the human body (typically acquired with a motion capture system). The AnyBody AnyGait is a tool for gait analysis with the following features: streamlined, intelligent musculoskeletal analysis, easily match the model to each subject, dynamic kinetic and kinematic results. Current analysis uses motion capture data and ground reaction forces. The tool essentially computes inverse dynamics while forward dynamics are still to be implemented.