

TRAMA *Training in Motion Analysis*

**Second Course "Motion Analysis and clinics:
why to set up a Motion Analysis Lab ?"**

TRAMA Project

January 14 - 17th 2008

Ing. V. Cimolin - Prof. M. Galli - Prof. M. Crivellini
Bioeng. Dept. Politecnico di Milano, Milano (ITALY)

Main Lab activity

Quantitative analysis of human posture and movement mainly for clinical and rehabilitative applications

Course "Motion Analysis and clinics: why to set up a Motion Analysis Lab ?"
TRAMA Project - January 14 - 17th 2008

The staff of our Lab

Course "Motion Analysis and clinics: why to set up a Motion Analysis Lab ?"
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The mission

Development of protocol, experimental set-up, software,... for a user-friendly application of movement and gait analysis in clinical field

↓

RESEARCH APPLIED IN CLINICS

Course "Motion Analysis and clinics: why to set up a Motion Analysis Lab ?"
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THE EQUIPMENT OF OUR LAB

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The equipment

↪ Optoelectronic system → KINEMATICS

ELITE2002 system (BTS, Milan, Italy)

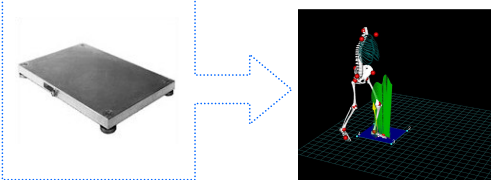
SMART-D system (BTS, Milan, Italy)

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The equipment

Force platforms → KINETICS

2 Force platforms (AMTI, USA)

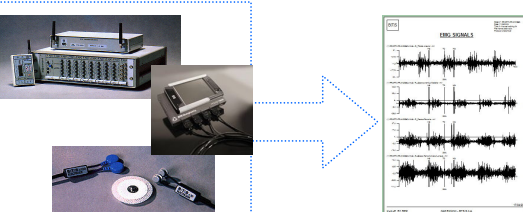


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The equipment

Electromyography → EMG

TeleEMG (BTS, Milan, Italy)
PocketEMG (BTS, Milan, Italy)




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The equipment

Video system → VIDEO RECORDING


VideoController (BTS, Milan, Italy)

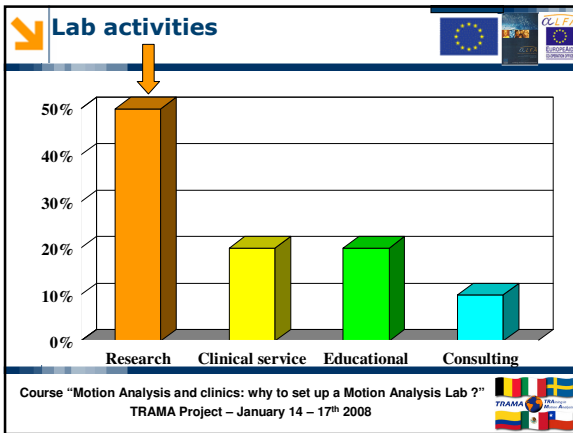





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
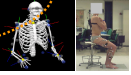

LAB ACTIVITIES


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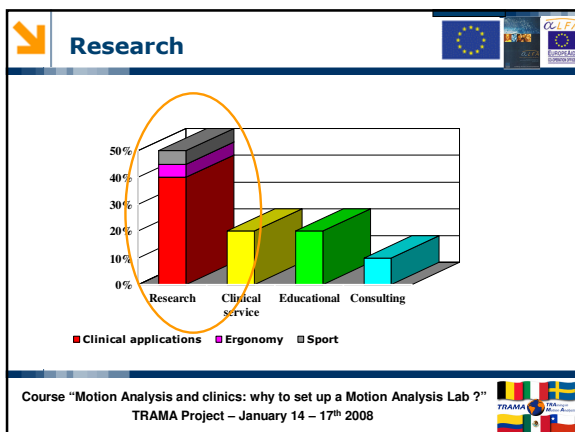



Research



- Quantification of pathological functional "imitation" and quantification of the effects of rehabilitation treatments
- Development of "ad hoc" set-up "ad hoc" for different pathologies
- Ergonomic and industrial applications
- Sport biomechanics

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**RESEARCH:
CLINICAL APPLICATIONS**

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- Research**
- Quantification of pathological functional limitation and quantification of the effects of rehabilitative treatments**
- ✓ Cerebral Palsy
 - ✓ Parkinson's disease
 - ✓ Down syndrome
 - ✓ Eating disorders
 - ✓ Amputees
 - ✓ ...
- Course "Motion Analysis and clinics: why to set up a Motion Analysis Lab ?"
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Research Cerebral Palsy

- Quantitative evaluation of functional limitation due to the pathology and its evolution over time;
- Quantitative evaluation of rehabilitative and therapeutical outcomes:
 - Orthopedic surgery
 - Botulinum toxin injection
 - Orthoses and assistive devices
 - Baclofen pump
 - Physiotherapy
 - ...
- Quantitative identification of the best rehabilitative and therapeutical program

In collaboration with:

- IRCCS "San Raffaele Pisana" and Casa di Cura "San Raffaele Cassino" - Tosinvest Sanità, Roma
- IRCCS "La Nostra Famiglia" Bosisio Parini (LC)
- Istituto "Humanitas" Rozzano (MI)
- Children's University Hospital Basel (UKKB), Switzerland
- University of Tartu, Tartu, Estonia

Course "Motion Analysis Lab ?"
2008

Research Cerebral Palsy

- M. Galli, G. Albertini, et al. Analysis of the correlation between three methods used in the assessment of children with cerebral palsy. *Funct Neurol*. 2007; 22(1):17-21.
- V. Cimolin, L. Piccinini, et al. Are patients with hereditary spastic paraplegia different from patients with spastic diplegia during walking? Gait evaluation using 3D Gait Analysis. *Functional Neurology* 200; 22 (1): 23-8
- V. Cimolin, M. Galli, et al. Gait strategy of uninvolved limb in children with spastic hemiplegia. *Europa MedicoPhysica* 2007; 43(3): 303-310.
- M. Galli, V. Cimolin, et al. Computerised gait analysis of Botulinum Toxin treatment in cerebral palsied children. *Disability & Rehabilitation* 2007;29(8):659-64
- Galli M., Cimolin V., et al. Gait analysis before and after lengthening of gastrocnemius fascia in children with Cerebral Palsy. *Journal of Applied Biomaterials and Biomechanics* 2005; 3 (2): 98-105
- Romei M., Galli M., et al. Use of Normalicy Index for the evaluation of gait pathology. *Gait And Posture*, Vol 19, pp 85-90, 2004
- Albertini G., Galli M., et al. Utilizzo della Gait Analysis nella valutazione dell'intervento chirurgico Ortopedico. *Europa MedicoPhysica*, Vol.37, Supp.1, pp. 893-895, 2001.
- Galli M., Crivellini M., et al. Short-term effect Botulinum Toxin A as a treatment for children with Cerebral Palsy : kinematic and kinetic aspects of ankle joint. *Functional Neurology* Vol. XVI N.4, pp.161-168, 2001.
- Galli M., Fazzi E., et al. Kinematic and dynamic analysis of the ankle joint in children with cerebral palsy *Functional Neurology*, Vol. XIV N.3 pp.135-140, 1999

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Research Parkinson's disease



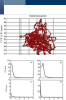
- Quantitative evaluation of gait and postural strategy related to the pathology;
- Quantitative evaluation of effects of Levodopa treatment on gait and postural control.

In collaboration with:

- Casa di Cura "San Raffaele Cassino" - Tosinvest Sanità, Roma

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Research Down syndrome


- Evaluation of the effect of orthopedic problems typical of Down syndrome (ligament laxity, hypotonia, flat foot) on gait and postural control;
- Quantitative motor and postural evaluation pre and post rehabilitative programs;
- Relationship between postural and gait indexes and NMR images;
- Development of new protocols for the evaluation of motor and cognitive impairment.

In collaboration with:


- IRCCS "San Raffaele Pisana" and Casa di Cura "San Raffaele Cassino" – Tosinvest Sanità, Roma
- Institute of Basic Research (IBR), Staten Island, NY.

• Rigoldi C., Galli M., et al. Gait alteration of a teenager with Down's syndrome: a 5-year follow-up before and after surgery. *J Pediatr Orthop B*. 2007;16(1):73-5.

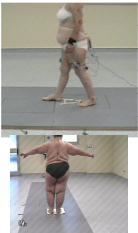
• Galli M., Rigoldi C., et al. Postural control in patients with Down Syndrome. *Disabil Rehabil* 2007 (in press).



Research Eating disorders




- ✓ Quantitative evaluation of the effect of obesity on postural and gait control;
- ✓ Quantitative evaluation of posture and gait strategy in anorexic subjects.



In collaboration with:

- IRCCS Istituto Auxologico di Piancavallo (VB)

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Research Amputees



- ✓ Gait analysis in subjects after ACL rupture and with knee prosthesis

In collaboration with:

- Casa di Cura "La Residenza" Rodello d'Alba (CN)
- Polisportiva Milanese, Milano



• Galli M., Sibella F., et al. Gait analysis in Anterior Cruciate ligaments. *Med. & Biol. Eng. & Comput.*, vol. 37, Supp.2, 820-821, 1999

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Research

... not only Gait Analysis

Development of experimental set-up "ad hoc" for different pathologies

- ✓ Upper limb movements
- ✓ Sit-To-Stand
- ✓ Energy expenditure during gait
- ✓ Posture
- ✓ ...

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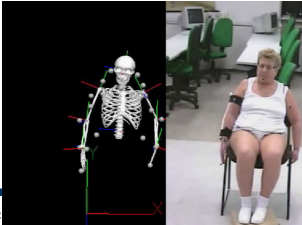
Research Upper limb movement

Development of protocols for the evaluation of upper limb movements

- Parkinson's disease → quantification of effects of Levodopa treatment
→ research for a correlation between quantitative parameters and UPDRS scale

In collaboration with:



- Istituto Neurologico "Carlo Besta", Milano




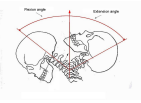
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Research Upper limb movement



Proximal movement

Axial movement

Distal movement


OFF state
ON state

Research Upper limb movement


Development of protocols for the evaluation of upper limb movements

- Cerebral Palsy

Frontal reaching

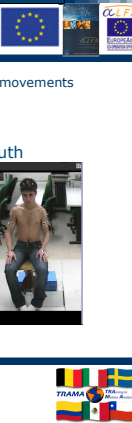


Hand to mouth



In collaboration with:

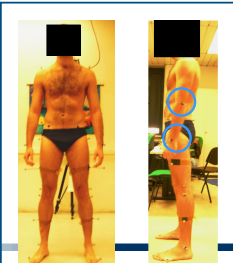

- IRCCS "San Raffaele Pisana" and Casa di Cura "San Raffaele Cassino" - Tosinvest Sanità, Roma
- Istituto Humanitas, Rozzano (MI)



Research Upper limb movement

Development of protocols for the evaluation of upper limb movements during gait

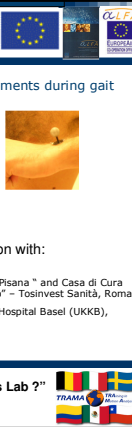
Davis' protocol (Davis, 1991) + Upper limb

In collaboration with:

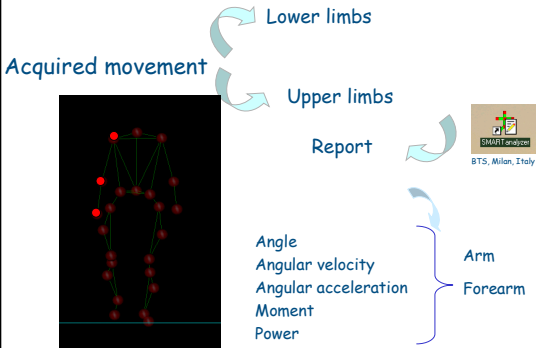
- IRCCS "San Raffaele Pisana" and Casa di Cura "San Raffaele Cassino" - Tosinvest Sanità, Roma
- Children's University Hospital Basel (UKKB), Switzerland

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Research Upper limb movement

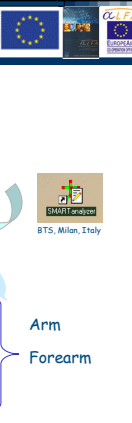
Acquired movement



Angle
Angular velocity
Angular acceleration
Moment
Power

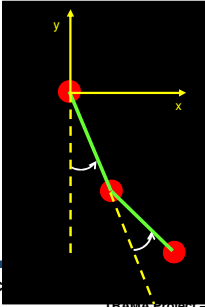
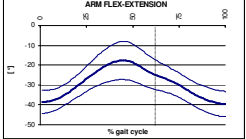
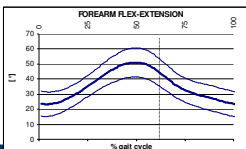
Arm
Forearm

SMART motion
BTS, Milan, Italy



Research Upper limb movement

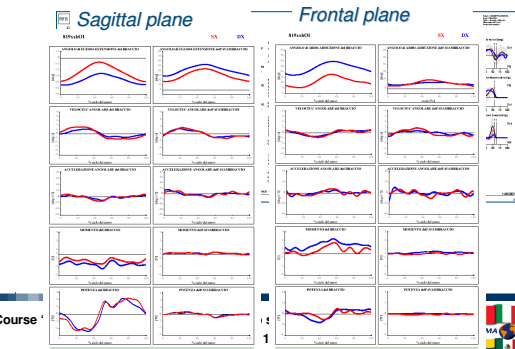
Sagittal plane

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Research Upper limb movement

Sagittal plane **Frontal plane**

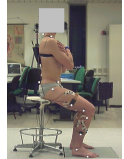


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Research Sit-To-Stand

Development of experimental set-up for the evaluation of STS movement

- Adult hemiplegic
- Obese subjects



In collaboration with:

- IRCCS Istituto Auxologico di Piancavallo (VB)
- LAM, Rehabilitation Dept., AUSL Reggio Emilia

• M. Galli, V. Cimolin, et al. Quantitative analysis of Sit To Stand movement: experimental set-up definition and application to healthy and hemiplegic adults. Gait & posture 2007 (in press)
• Sibella F., Galli M., et al. Biomechanical analysis of Sit To Stand Movement in normal and obese subjects , Clinical Biomechanics, 18 pp.745-750 2003.

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Research
Energy expenditure during gait

Development of experimental set-up for the quantification of energy expenditure during gait analysis in CP patients

Experimental set up:
 SESS1: Gait Analysis
 SESS2: Gait Analysis + K4b²

In collaboration with:

- IRCCS "La Nostra Famiglia" Bosisio Parini (LC)

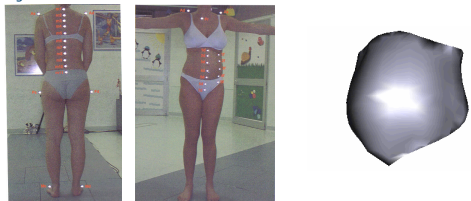


• L. Piccinini, V. Cimolin, et al. Quantification of energy expenditure during gait in children affected by Cerebral Palsy. *Europa MedicoPhysica* 2007 Mar;43 (1):7-12.
 • V. Cimolin, M. Galli, et al. Quantitative analysis of gait pattern and energy consumption in children with Cerebral Palsy. *Journal of Applied Biomaterials and Biomechanics* 2007; 5: 28 - 33

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Research
Posture

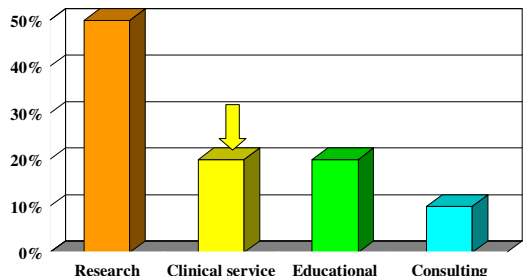
Development of protocols for the evaluation of posture and movement analysis in pregnant women



• Divieti L., Galli M., et al. Posture and movement in pregnancy, *Mathematical Models and Methods in Applied Sciences*. Vol. 5 No.2 pp. 145-157, 1995

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Lab activities




Activity	Percentage
Research	50%
Clinical service	20%
Educational	20%
Consulting	10%

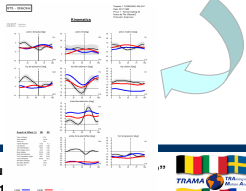
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Clinical Service

Execution of movement analysis tests for hospitals that have not a Motion Analysis Lab.

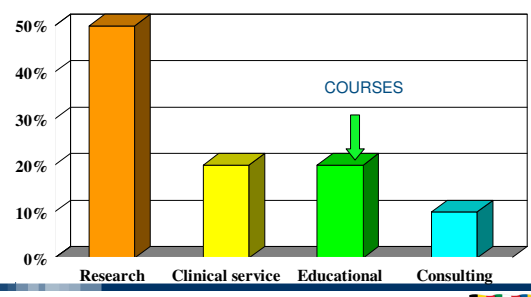


ISTITUTO "HUMANITAS" Rozzano (Mi)
 ISTITUTO NEUROLOGICO "C.BESTA", Milano
 ISTITUTO NEUROLOGICO "C.MONDINO", Pavia
 ISTITUTO TUMORI, Milano



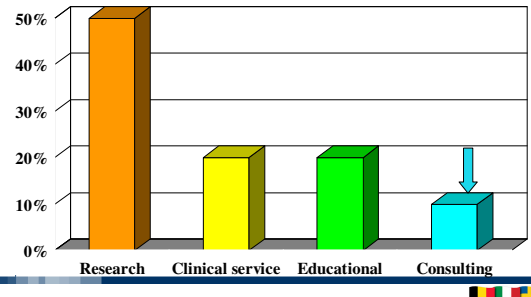
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Lab activities



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Lab activities



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Consulting/Training activity

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Consulting/Training activity

TRAMA Project (TRaining in Motion Analysis)
Programme αLFA (America Latina – Formacion Academica)
→ Network among EU and LA Institutions aim to *training* in Motion Analysis

Course "M"

Consulting/Training activity

Course "M"

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Research

**Development of new protocols ...
not only for clinics**

Ergonomic and industrial applications

Sport biomechanics

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Research
Ergonomic and industrial applications



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Research
Ergonomic and industrial applications




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**Research
Motion capture**



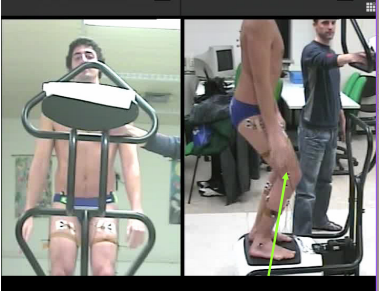
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**Research
Sport biomechanics**



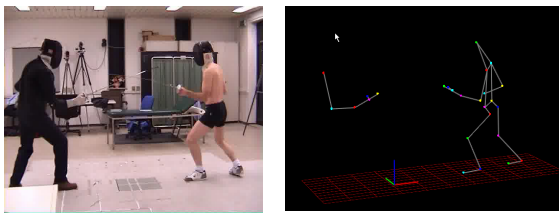
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**Research
Sport biomechanics**



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Research Sport biomechanics



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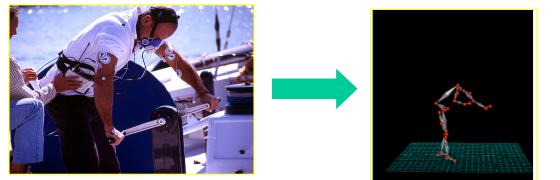
Research Sport biomechanics



Sail Academy

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Research Sport biomechanics



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