



# LaBACS Equipment

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A quick overview of selected  
equipment



# Presentation outline

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- EMG System
- Camera based systems
  - \* DV camera system
  - \* Webcam system
  - \* Fast camera system
- Motion sensors
- Force plate
- Human modeling software
- Data acquisition cards

# EMG System

## **DELSYS Bagnoli EMG System**

Delsys Inc., Boston, MA, USA

<http://www.delsys.com>

Main components of the system include:

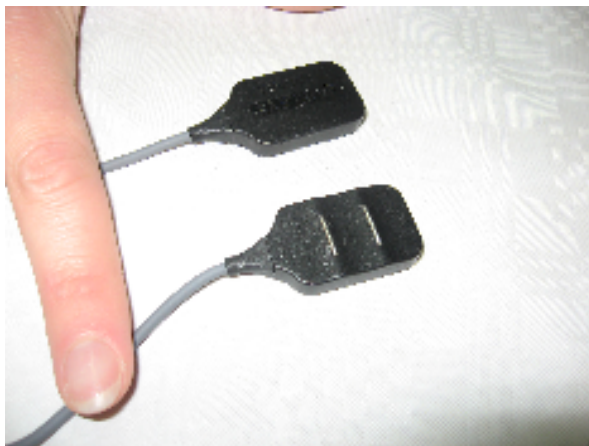
Main amplifier

- 4 channel amplifier
- Amplification rate of: 100, 1k, 100k
- Frequency range: 20-450Hz
- Dimensions: 205x108x38 mm
- Mass: 0.5kg



# EMG System

- System bus
  - Collects data 4 electrodes and 1 reference electrode and sends it to main amplifier
  - Mass: 64g
  - Dimensions: 61x58x25 mm

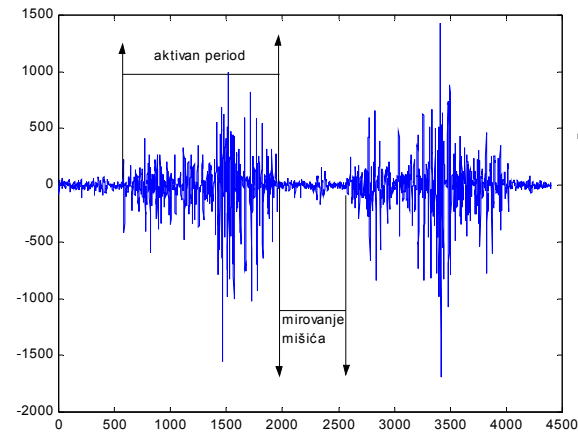
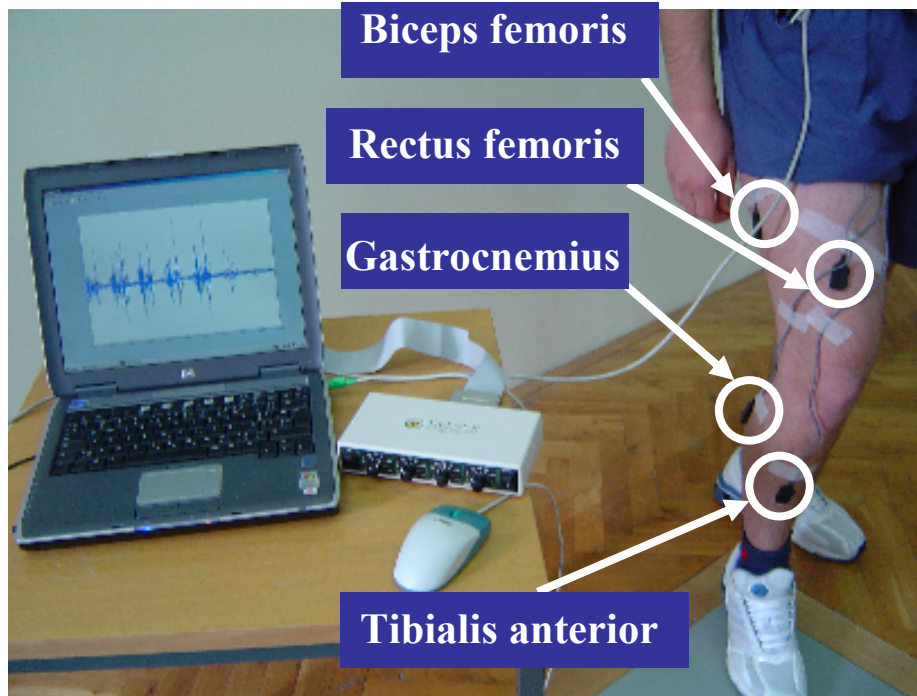


- Surface electrodes
  - Single differential
  - Case dimension: 41x20x5 mm
  - Noise: 1.2uV (RMS, R.T.I.)
  - Input impedance:  $> 10^{15} \Omega // 0.2\text{pF}$

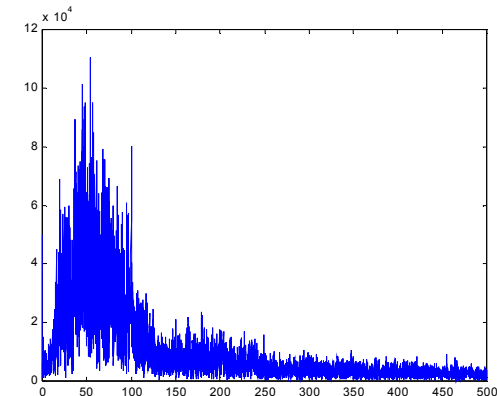


# EMG System

- Application example: EMG measurements on leg muscles



Frequency spectra of EMG signal





# EMG System

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- **Selected publications:**

1.) Grujić-Šupuk, Tamara; Kuzmanić, Ana.

**Denoising of Surface EMG Signals: A Comparison of Wavelet and Classical Digital Filtering Procedures.** // *Journal of Technology and Health Care*. 12 (2004) ; 130-135

2.) Panjkota, Ante; Šupuk, Tamara; Zanchi, Vlasta.

**Correlation of EMG activity and kinematics in case of ergometer rowing** // *Proceeding of WSEAS International Conference on Automation & Information (ICAI'06)* | Rudas, Imre J ; Bardis, Nikos ; Papic, Vladan (edt.). WSEAS, 2006. 23-28

3.) Panjkota, Ante; Musić, Josip.

**Muscle Activity During Ergometer Rowing** // *Proceedings of the Third IASTED International Conference on "Biomedical Engineering"* | Hamza, M.H. (edt.). Anaheim-Calgary-Zurich : ACTA Press, 2005. 652-656

4.) Šupuk Grujić, Tamara; Zanchi, Vlasta.

**The Measurement Of Muscle Activation Intervals From Semg Signals Denoised By Wavelet Filtering Procedure** // *Proceedings of BioMED 2003* | M.H.Hamza (edt.), Salzburg, Austria : ACTA Press, 2003. 11-16

# Camera based systems

## **DV camera based system (2 x Sony DCR-TRV110E)**

Sony, Japan

<http://www.sony.com>

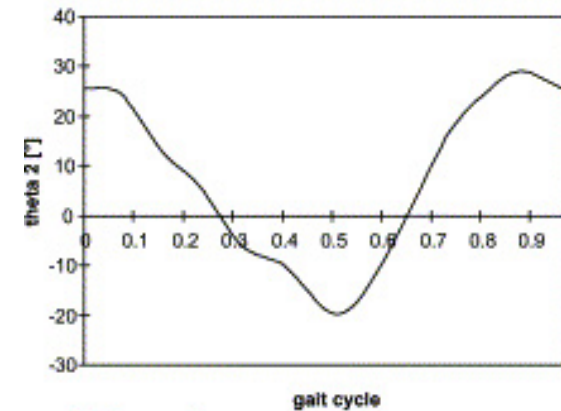
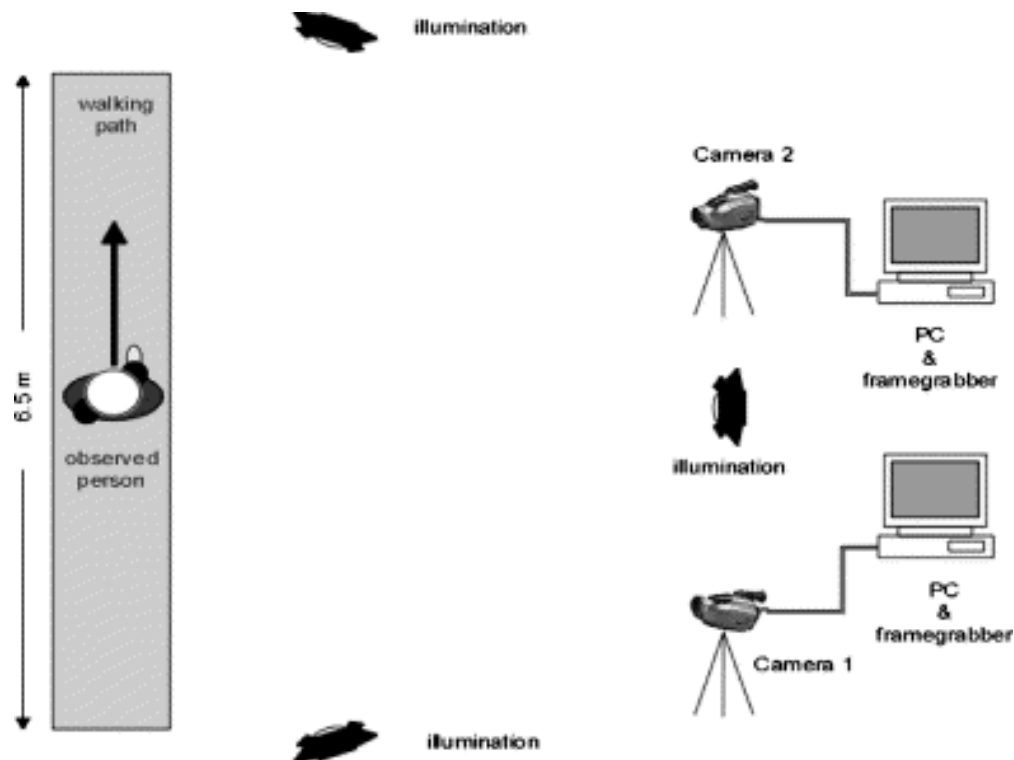
Data sheet:

- Optical sensor type: CCD
- Effective video resolution: 400kpix
- Analog video format: PAL
- Computer interface: composite
- Optical zoom: 20x
- Frame rate: max. 50fps
- Mass: 0.9kg

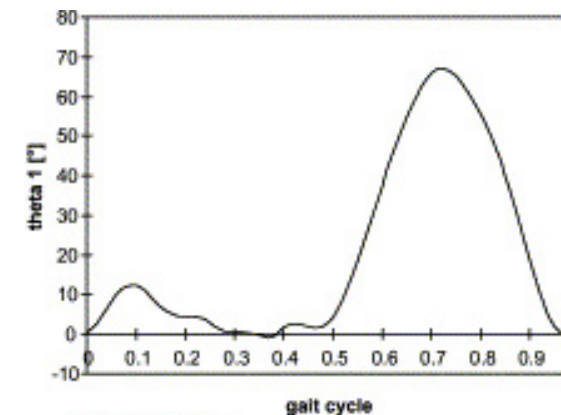


# Camera based systems

- Application example - 3D coordinate reconstruction using 2 cameras



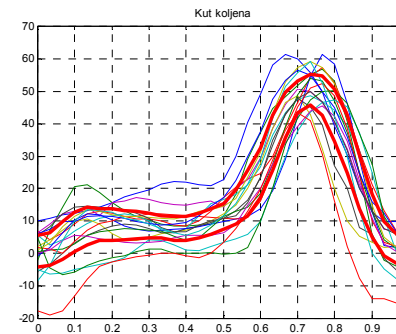
Ankle angle (a)



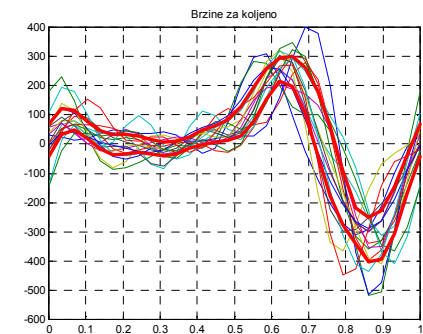
Knee angle (b)

# Camera based systems

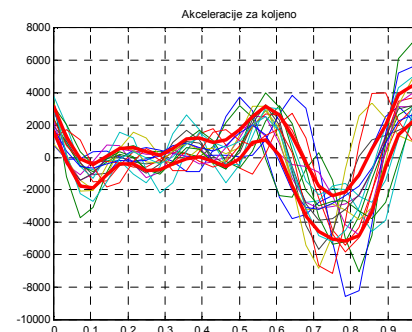
- Application example – Treadmill walking



Ankle position



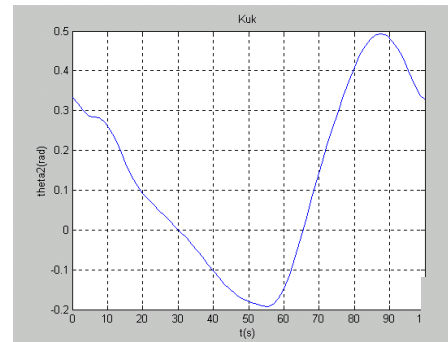
Ankle speed



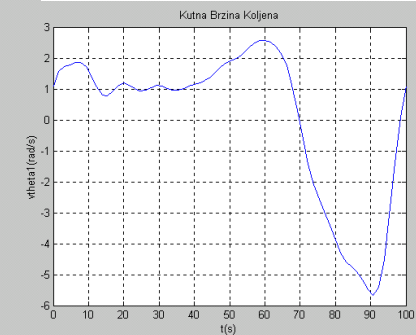
Ankle acceleration

# Camera based systems

- Application example – sit to stand movement

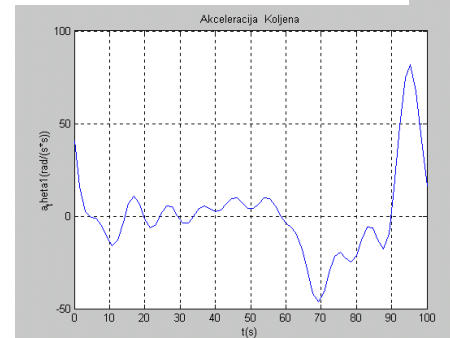


Knee position



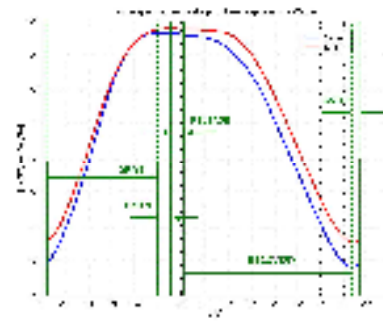
Knee speed

Knee acceleration



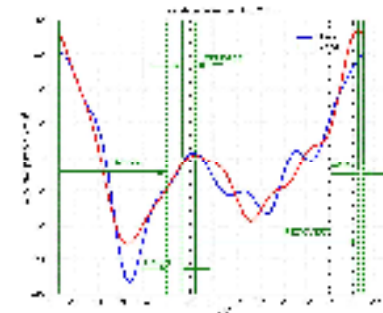
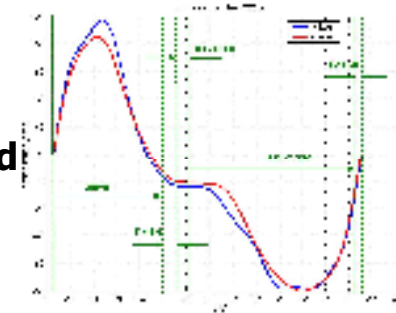
# Camera based systems

- Application example - Rowing



Rowing cart position

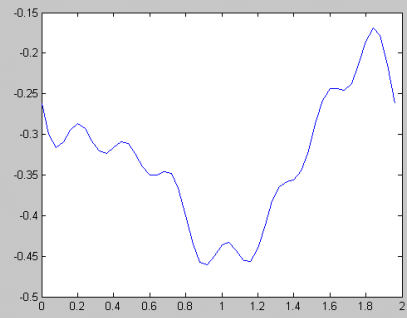
Rowing cart speed



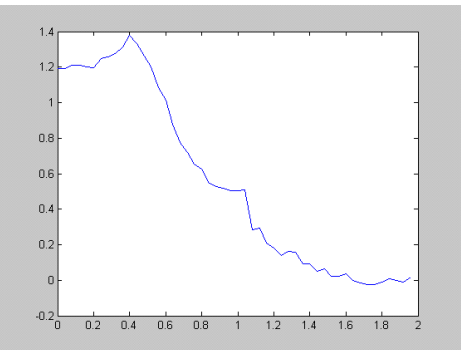
Rowing cart acceleration

# Camera based systems

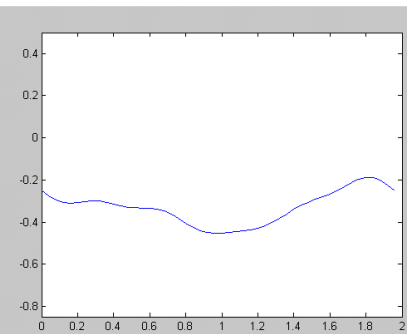
- **Application example – Human gait**



**Knee position**



**Knee speed**



**Knee acceleration**





# Camera based systems I

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- **Selected publications:**

- 1.) Papić, Vladan; Zanchi, Vlasta; Krstulović, Ante.  
**Distributed Gait Measurements** // *Virtual Reality Technologies for Future Telecommunications Systems / Algirdas Pakštas ; Ryoichi Komiya (edt.)*, Chichester : John Wiley & Sons Ltd., 2002. pp. 215.
- 2.) Papić, Vladan; Zanchi, Vlasta; Cević, Mojmil.  
**Motion analysis system for identification of 3D human locomotion kinematics data and accuracy testing.** // *Simulation Modelling Practice and Theory*. 12 (2004) , 2; 159-170
- 3.) Kuzmanić, Ana; Musić, Josip.  
**Identification Of Human Kinematics by FSBM Algorithm.** // *Journal of Technology and Health Care*. 12 (2004) ; 113-115
- 4.) Zanchi, Vlasta; Šupuk, Tamara.  
**Measure of Quality in State Space.** // *WSEAS Transaction on Systems*. 3 (2004) , 2; 584-589
- 5.) Papić, Vladan; Zanchi, Vlasta.  
**Comparison of the automatic marker-less body segments tracking and the traditional marker-based approach** // *Proceedings of The 3rd European Medical and Biological Engineering Conference EMBEC'05*, Prague, 2005.



# Camera based systems

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## **Webcamera (2 x Logitech Quickcam)**

**Logitech, Switzerland**

**<http://www.logitech.com>**

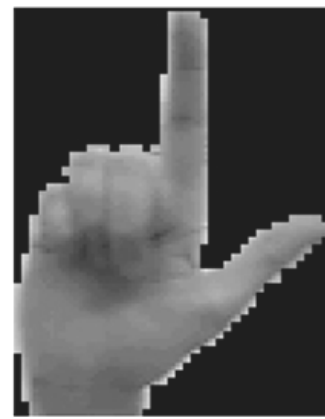
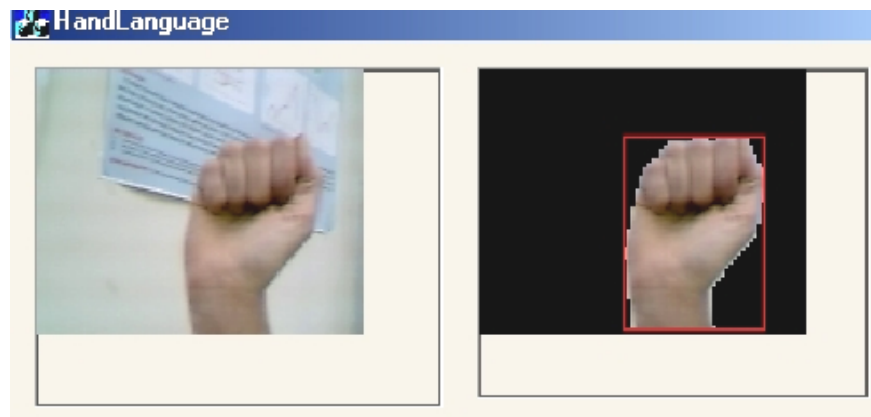
Data sheet:

- Optical sensor type: CMOS
- Video resolution: max. 640x480
- Analog video format: AVI
- Computer interface: USB
- Optical zoom: none
- Frame rate: max. 30fps
- Mass: 0.2kg



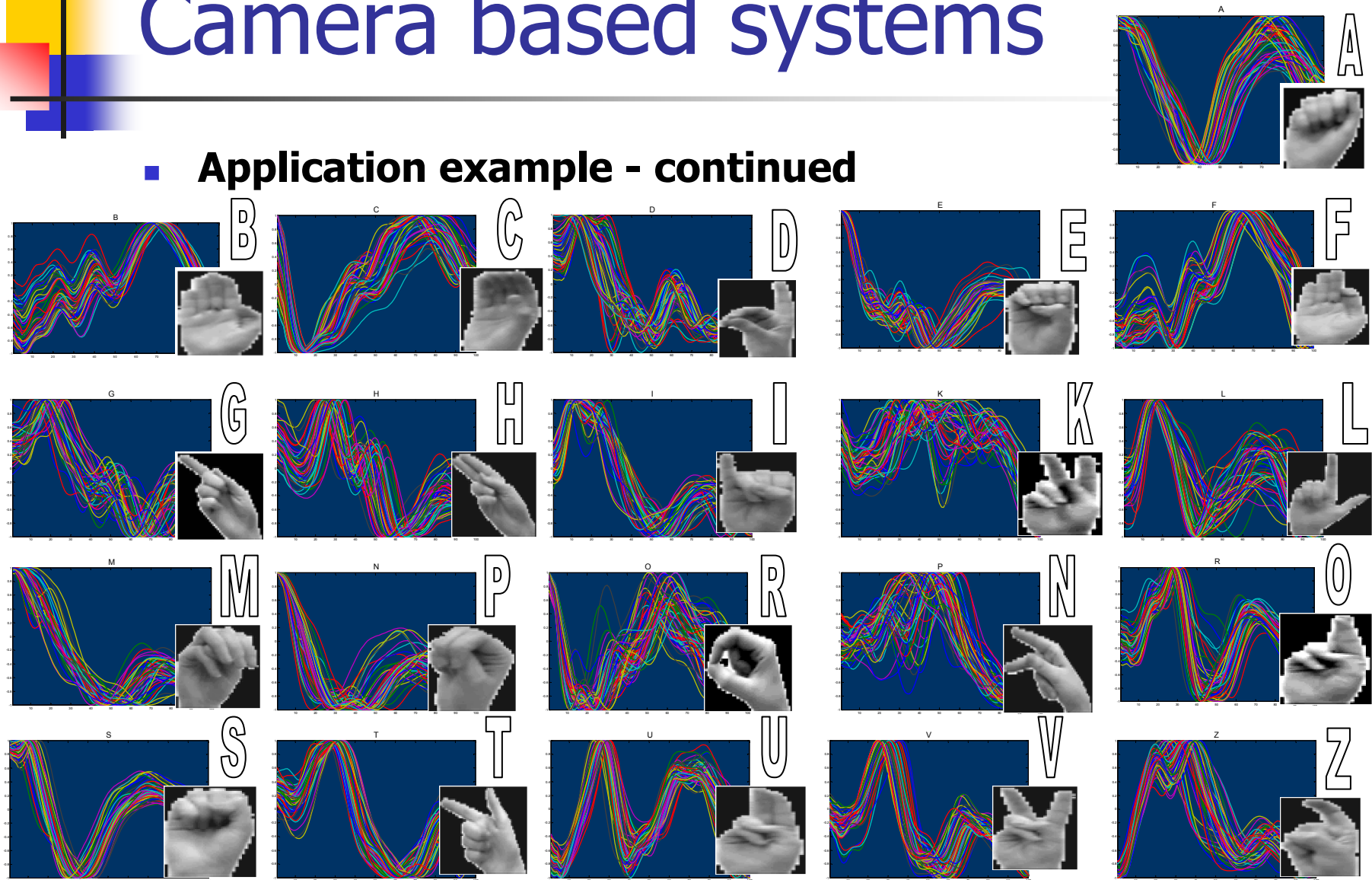
# Camera based systems

- Application example – Croatian sign language recognition



# Camera based systems

- Application example - continued





# Camera based systems II

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- **Selected publications:**

1.) Kuzmanić, Ana; Zanchi, Vlasta

**Hand Shape Classification using DTW and LCSS as similarity measure for vision-based gesture recognition system** // Proceedings of IEEE Region 8 EUROCON 2007, Warsaw, Poland, 9-13 September, 2007

2.) Kuzmanić, Ana; Zanchi, Vlasta

**Vision-based recognition of hand shapes in Croatian Sign Language (CROSLAN)** // Proceedings of CIS (Intelligent Systems), MIPRO 2007, Opatija, Croatia, 21-25 May, 2007

3.) Kuzmanić, Ana.

**Modeling Feature Signals for Vision-Based Hand Posture Classification** // *Proceedings of the Third IASTED International Conference on "Biomedical Engineering"* / Hamza, M.H. (edt.). Anaheim ; Calgary ; Zurich : ACTA Press, 2005. 647-651



# Camera based system

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**Fast camera system**

**2 x Basler A602fc**

Basler Vision Technologies, Germany

<https://www.baslerweb.com>





# Camera based systems

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- **Fast camera system (Basler A602fc\*)**

Data sheet:

- Optical sensor type: CMOS
- Video resolution: max. 656x490
- Video output format: YUV 4:2:2, Raw 8, Raw 16
- Frame rate: max 300fps (@ 480x215pix)
- Lens: C-mount (we are using Fujinon TV lenses 1:1.4/12.5mm)
- Computer interface: IEEE1394a or RJ-45
- Mass: 100g
- Optical zoom: none

\* camera system is still in setting up process / testing phase



# Motion sensors

## **XSens MTx (2 sensors) & Xbus master**

**Xsens technologies B.V., Netherlands**  
<http://www.xsens.com>



Data sheet:

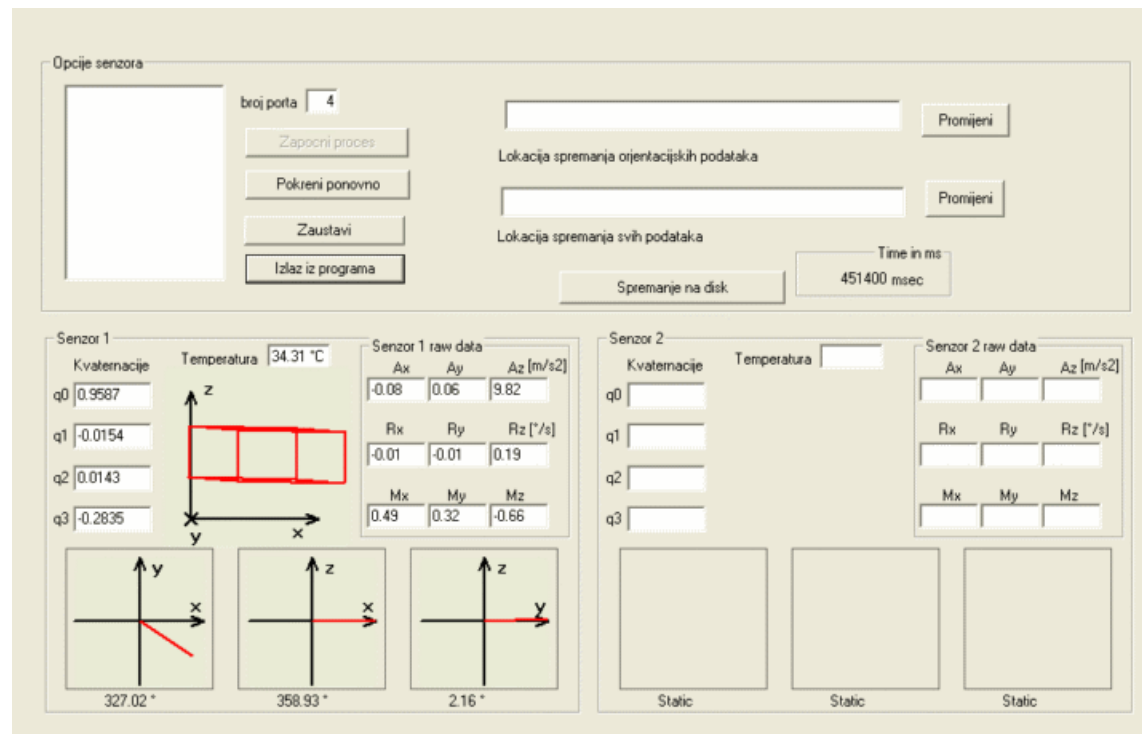
- Dimensions (WxLxH): 38x53x21mm
- Mass: 30g
- Digital interface (Xbus): USB
- Output: 3D orientation, 3D acceleration  
3D rate-of-turn, 3D earth magnetic  
field, Temperature
- Max. update rate: 120Hz
- Full scale (rate-of-turn / acceleration):  
 $\pm 1200 \text{ deg/s}$        $\pm 17 \text{ m/s}^2$





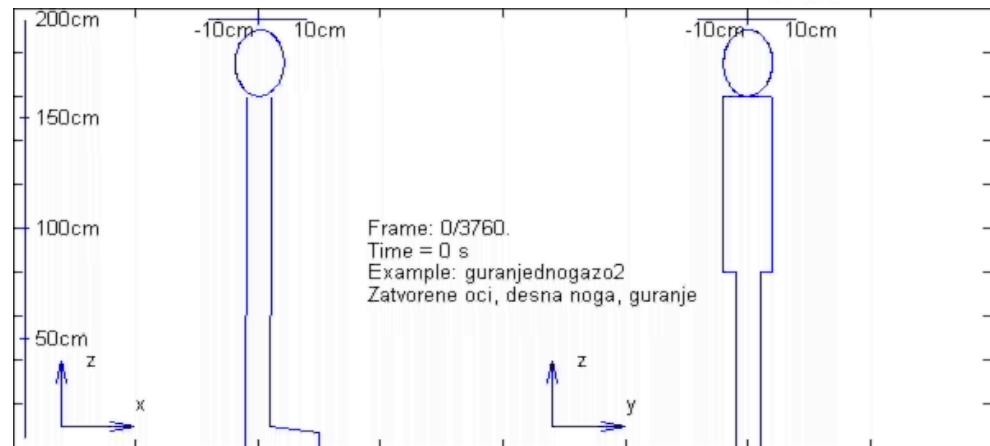
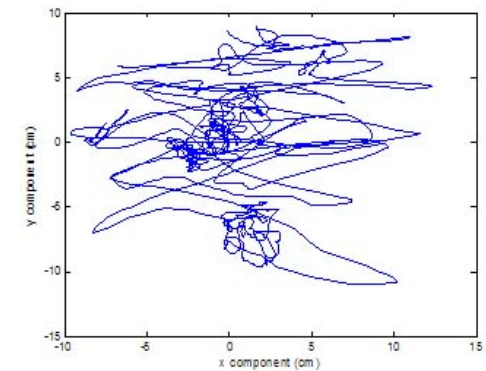
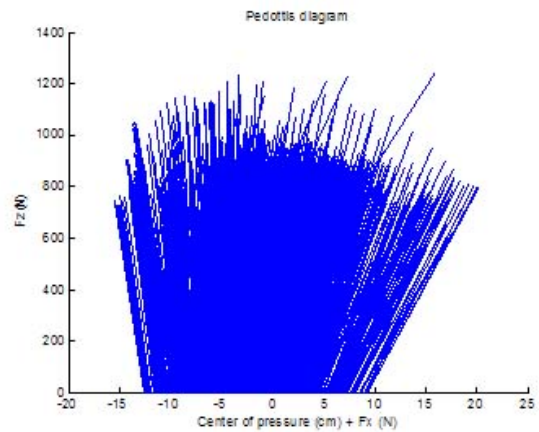
# Motion sensors

- We have been working on development of our own software support (GUI of beta version is presented below) to collect and analyze data



# Motion sensors

- Application example: Stability in postural control





# Motion sensors

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- **Selected publications:**

- 1.) Kamnik, Roman; Musić, Josip; Burger, Helena; Munih, Marko; Bajd, Tadej.  
**Design of Inertial Motion Sensor and its Usage in Biomechanical Analysis** // *Proceedings of 4th International Conference on Electrical and Power Engineering* / Cretu, Mihai (edt.). Iasi, Romania : Institutului Politehnic din Iasi, 2006. 511-516
- 2.) Stancic, Ivo; Šupuk, Tamara; Rogulj, Nenad.  
**Stability in human postural control** // *Proceeding of WSEAS International Conference on Automation & Information (ICAI'06)* / Rudas, Imre J ; Bardis, Nikos ; Papic, Vladan (edt.). WSEAS, 2006. 29-31
- 3.) Podrug. Stjepan; Zanchi. Vlasta.  
**Measurement And Analyses Of Postural Stability** // *Proceeding of The 3rd European Medical and Biological Engineering Conference EMBEC'05* , Prague, 2005.



# Force plate

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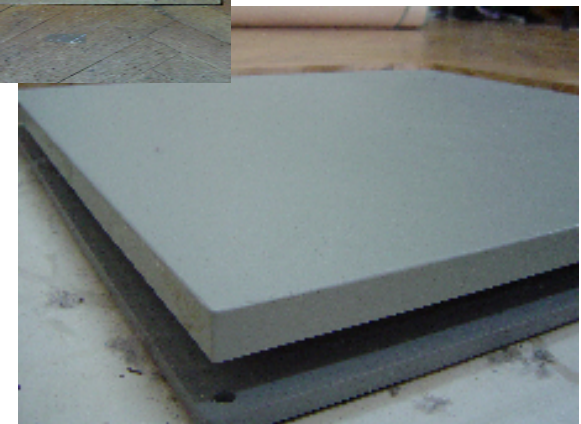
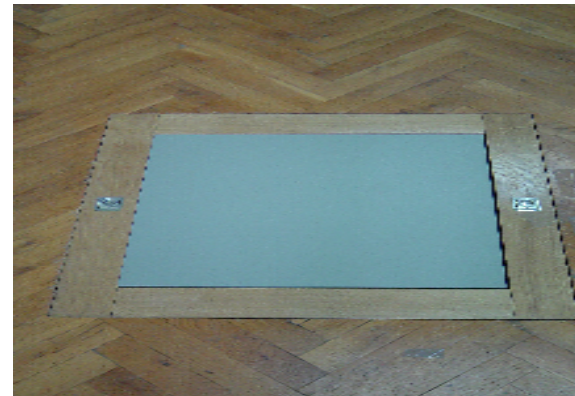
## **AMTI AccuGait**

Advanced Mechanical Technology Inc., USA

<http://www.amti.biz>

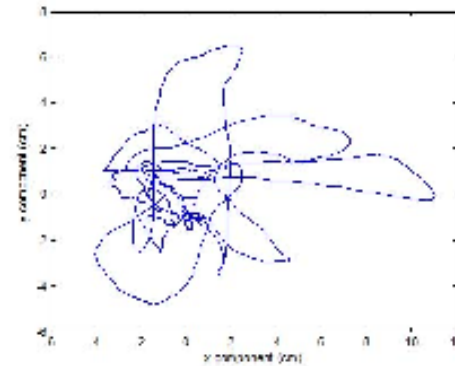
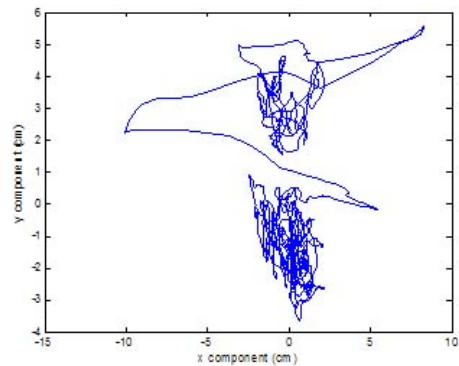
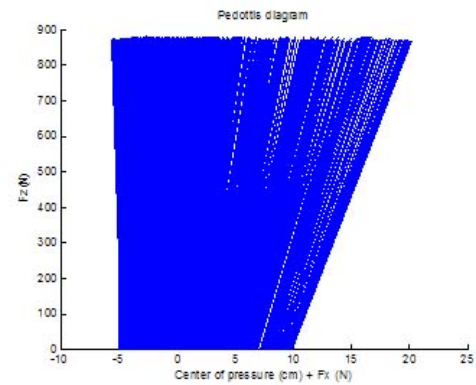
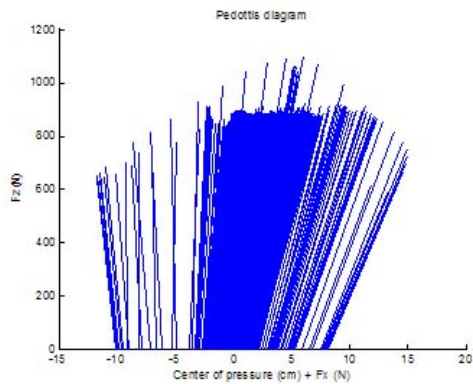
Data sheet:

- Max Fz: 2720N
- Max Fx, Fy: 450N
- Filter: low-pass analogue filter (300Hz)
- Mass: 11.4kg
- Dimensions (HxLxW): 44x500x500mm
- Data sampling rate: 50, 100 and 200 samples per second
- Computer interface: RS232
- Voltage: 12V



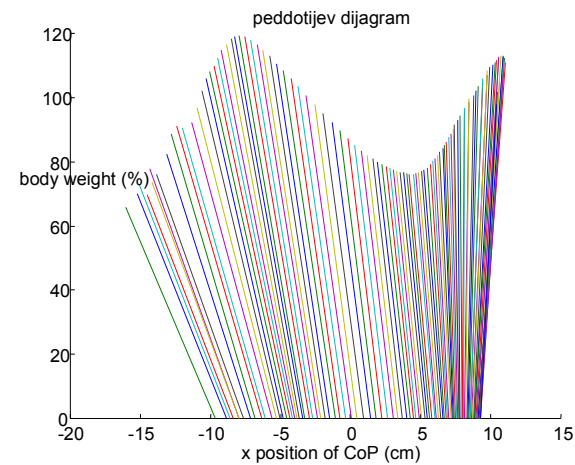
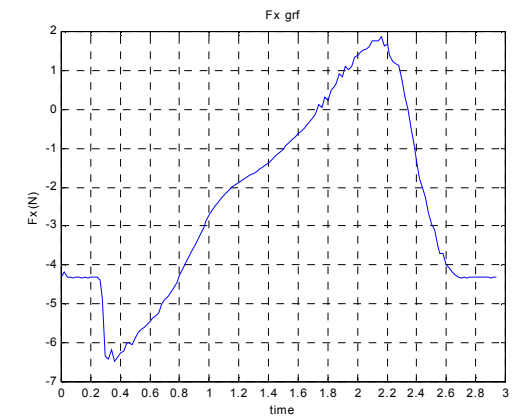
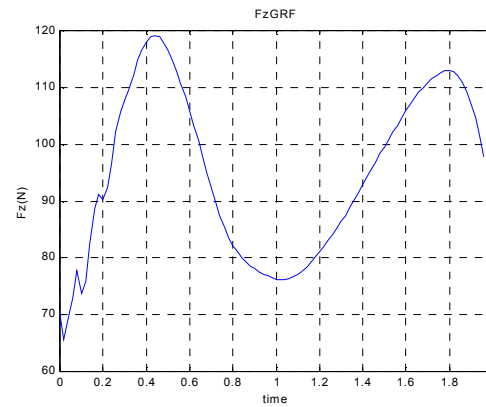
# Force plate

- **Application example: stability in postural control**



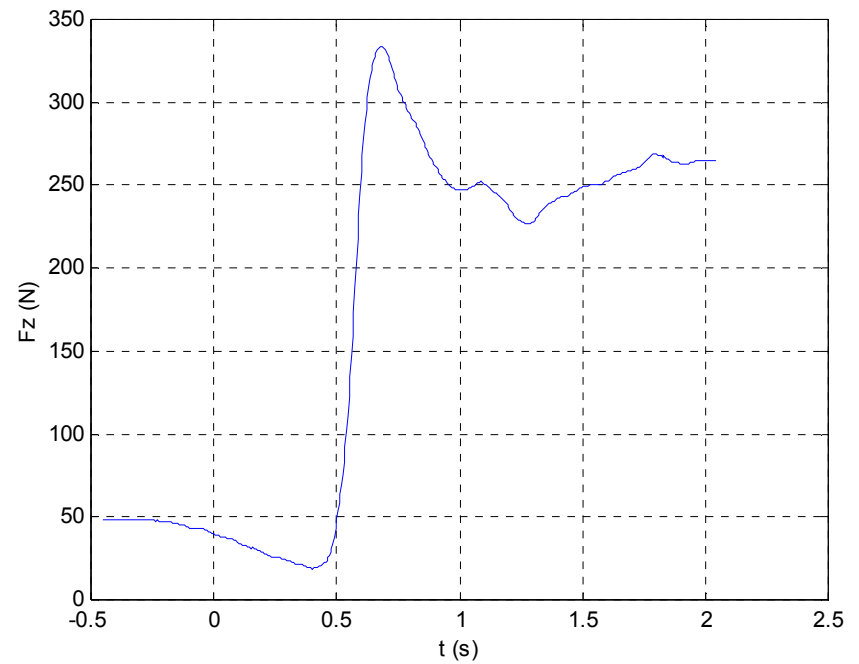
# Force plate

- **Application example: Analysis of ground reaction forces during normal gait**



# Force plate

- **Application example: Sit-to-stand movement**





# Force plate

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- **Selected publications:**

- 1.) Grujić Šupuk, Tamara; Kuzmanić, Ana; Kuželički, Jernej; Zanchi, Vlasta.  
**Estimation of vertical component of ground reaction force during sit to stand movement: Direct Dynamics Approach** // *Proceedings of 11th International Electrotechnical and Computer Science Conference ERK 2002* | Baldomir Zajc (edt.). Ljubljana, Slovenia : IEEE, 2002. 225-228
- 2.) Kuzmanić, Ana; Grujić Šupuk, Tamara.  
**Identification of kinematics and kinetics of human gait** // *Proceedings of 2nd European Medical&Biological Engineering Conference EMBEC'02 - indeksirano u INSPEC bazi* | Helmut Hutten, Peter Krosi (edt.). Viena, Austria, 2002. 824-825
- 3.) Zanchi, Vlasta; Cević, Mojmil; Šupuk Grujić, Tamara; Kuzmanić, Ana; Papić, Vladan.  
**Laboratory for Identification of Human Movement with LABACs Software Support** // *Proceedings of the International Congress on Computational Bioengineering* | Doblare, M. ; Cerrolaza, M. ; Rodriguez, H. (edt.). Zaragoza, Spain, 2003. 155-161
- 4.) Zanchi, Vlasta; Šupuk, Tamara.  
**Human Motion Identification** // *Workshop on Signals and Systems in Human Motion* | Begusic, Dinko ; Dujmić, Hrvoje ; Zanchi, Vlasta (ur.). Split : Faculty of Electrical Eng, Mech.Eng and Naval Arch.-Split, 2004. 1-7





# Human modeling software

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## **AnyBody modeling software**

**AnyBody Technology A/S, Denmark**

**<http://www.anybodytech.com>**

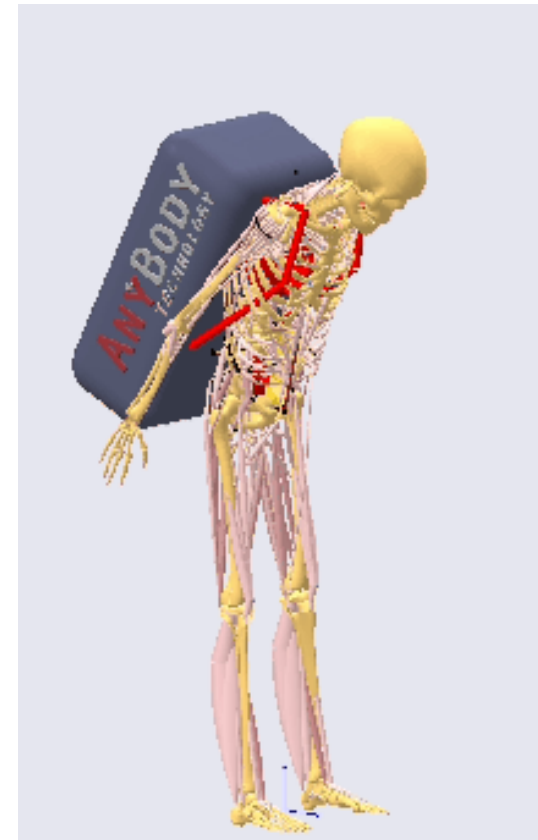
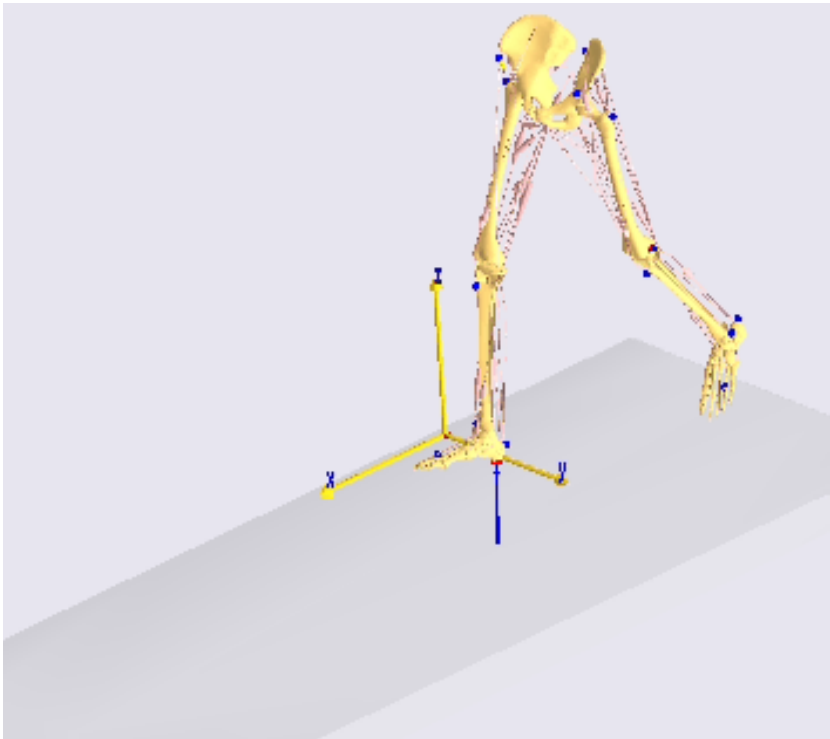
Basic information:

- handles static and dynamic models
- models are fully three-dimensional
- runs on the MS Windows platform
- handles very large models (It is entirely feasible to analyze a model with several hundreds of muscles on an ordinary PC )
- models are developed in the body modeling language AnyScript
- it is self-contained
- It uses an optimization technique to solve the muscle recruitment problem
- number of application fields: Biomechanical research, Ergonomic design, Computer-assisted surgery, Planning of physiotherapy, Sports and fitness, Design of rehabilitation technology



# Human modeling software

- **Application examples\*:**



\* not done in our laboratory; it is still in setting up phase

# Data acquisition cards

- There are number of data acquisition cards in our laboratory; just as an example we would like to present one of them

## NI Portable Data Acquisition Card DAQPad 6052E

Data sheet:

- Interface: IEEE1394 (Firewire)
- Max. sampling rate: 333kS/s
- Number of channels: 16SE/8DI (analog input)  
2 (analog output)  
8 DIO (digital input/output)
- Resolution: 16bits
- On board memory: 512 samples
- Number of counters/Timers: 2
- Dimensions (LxWxH): 30.7x25.4x4.3cm



**National Instruments, USA**  
<http://www.ni.com>

We also have NI BP-1 Battery Pack making the DAQPad 6052E fully mobile