AREA

UNITED KINGDOM

EUROPE

I. BIRMINGHAM, ENGLAND

ADDRESS
Biomechanics Laboratory
Physical Education Department
University of Birmingham
P.O. Box 363
Birminghan B15 2TT, England

Researcher: A. Howard Payne

I. EQUIPMENT

Biomechanical.

Runway:	Total length 100.0 m +		
	Run-in: up to 100 m	Effective length 2.0 M	Run-out 10.0 m
	Force plate	Accelerometer	
	Cine	Video	

Physiological.

nil

II. PARAMETERS

Both limbs recorded singly or simultaneously
Motions: Linear: Stride length, cadence, velocity
Forces: Ground Reaction: Vertical, AP and ML shear, center of pressure

Processing - Manual, Motion Analyzer, Computer

Range: Largest forces in sporting activities
Experimental error: ± 5%
Time: Force plate: instant
Film: 7-10 days

III. PHILOSOPHY

This laboratory is concerned with biomechanics in sport. It has gait analysis capabilities. The Force Platform Group includes many researchers in gait. A document "A Catalogue of Force Platforms" and a periodic Newsletter can be obtained from the director.

II. GLASGOW, SCOTLAND

ADDRESS
oengineering Unit
University of Strathclyde
Wolfson Center
106 Rottenrow
Glasgow G4 ONW, Scotland

Directors: John P. Paul, Ph.D.
John Hughes

Deputy: N. Berme, Ph.D.

I. EQUIPMENT

Biomechanical.

Walkway: Total length 17.0 m

Run-in 7.0 m	Effective length 3.0 m	Run-out 7.0 m
Force plate	Pylon dynamometers	
Cine	Video	

Physiological.

EMG surface electrode Cardiac rate

II. PARAMETERS

Recorded singly or simultaneously
Motions: Linear: Stride length, cadence, swing and stance, velocity, gait width
Spatial Relations: Joints and segments
Angular: Hip, knee, ankle and foot in three planes
Forces: Ground Reaction: Vertical, AP and ML shear, center of pressure
Joints: Compression, tension, shear in hip, knee, and ankle
Bones: Compression, tension, shear in pelvis, femure, tibula and fibula
Muscular Tension: In major groups only
Physiological: EMG

Processing - Manual, Motion Analyzer, Computer, and Analog Computer
Combined Computer/Television/Force Platform/
Sampling rate: 30-200 Hz Dynamometer System
Time: 1-3 days Immediate playback of digital record.

III. PHILOSOPHY

The assessment and evaluation of the normal and the disabled must involve the basic mechanisms whose function is impaired - i.e. muscular force, joint loading.

IV. PROJECTS

This well-established unit is involved in a multiplicity of research projects as follows: (a) Evaluation of modular systems of construction for below-knee prostheses. (b) Development of a kneeless, telescopic, energy storing leg for above knee amputees. (c) Development and evaluation of prostheses

Glasgow cont.

for through-knee amputation. (d) Biomechanical matching of prostheses and patient at above-knee amputation level. (e) Assessment and development of materials and techniques for fitting of prostheses and orthoses. (f) Development and evaluation of prostheses for hip disarticulation patients. (g) Assessment of characteristics of patient/orthosis at lower limb level. (h) Assessment of proprioception and position awareness in normal and pathological patients. (i) Assessment of biomechanical function of endo prostheses for hip and knee joints. (j) Development of a television computer system for analysis of human locomotion. (k) Biomechanical studies of the shoulder, elbow and finger joints. (l) Studies of the kinematics of the head, arms and trunk in normal and pathological gait. (m) Development of a telemetry system for physiological measurement to assess amputee performance. (n) Evaluation of supracondylar suspension techniques on PTB below-knee prostheses. (o) Evaluation of a cosmetic below-knee orthosis fabricated in polypropylene. (p) Development of an on-line PDP 12 signal processing facility for studies in human biomechanics, tissue mechanics and the assessment of cardiac function. (q) Long term ambulatory physiological surveillance. (r) Physiological cost of ambulation in the disabled.

III. LONDON, ENGLAND

ADDRESS
Biomechanical Research and Development Unit
Department of Health and Social Security
Roehampton Lane
London SW 15, England

Director: Prof. R.M. Davies
Deputy: R.B. Lawrence

I. EQUIPMENT

Biomechanical.

Walkway: Total length 13.0 m

Run-in 4.0 m	Effective length 5.0 m		Run-out 4.0 m
Force plate	Foot switch	Elgons	Accelerometer
Foot print records			
Cine	Strobe		Video

Physiological.

EMG surface electrodes

II. PARAMETERS

Limbs recorded singly or simultaneoulsy
Motions: Linear: Stride length, cadence, swing and stance, velocity, gait width
Spatial Relations: Joints and body segments
Angular: All joints in three planes
Forces: Angular Moments: Hip, knee, and ankle in sagittal and transverse planes
Ground Reaction: Vertical, AP and ML shear, center of pressure
Physiological: EMG

Processing:

Varied

IV. MANCHESTER, ENGLAND

ADDRESS
Biomechanics Laboratory
Department of Mechanical Engineering
University of Manchester Institute of
Science and Technology
P.O. Box No. 88
Sackville Street
Manchester M60 1QD, England

Director: Ronald D. McLeish

I. EQUIPMENT

Biomechanical.

Walkway: Total length 6.5 m
Run-in 1.5 m Effective length 3.0 m Run-out 2.0 m
Force plate Foot switch
Cine

Physiological.

nil

II. PARAMETERS

Both limbs recorded singly or simultaneously
Motions: Linear: Stride length, cadence, swing and stance, velocity
Spatial Relations: Joints and body segments
Angular: All joints in sagittal plane; hip, knee, ankle in coronal plane; foot in transverse plane
Forces: Angular Moments: All joints - all planes in stance only
Ground Reaction: Vertical, AP and ML shear, center of pressure
Joints: All - compression, tension, and shear
Bones: Nil
Muscular Tension: Major groups only

Processing - Manual for cine, Computer for force plate

Sampling rate: Up to 3,000 Hz; normal 100 Hz
Experimental error: ± 5%
Time: Force plate: 4 hours
Cine: 5 days

V. OXFORD, ENGLAND

ODDRESS
Oxford Orthopaedic Engineering Center Director: Dr. J.W. Morris
University of Oxford
Nuffield Orthopaedic Center
Headington, Oxford OX3 7LD
England

I. EQUIPMENT

Biomechanical.

Walkway:	Total length 5.0 m		
	Run-in 2.0 m	Effective length 5.0 m	Run-out 2.0 m
	Force Plate	Accelerometer	
	Cine	Video	

Physiological.

nil

Physical Resources

1. Space

   11.5m x 9.6m (can be enlarged to 15.5m x 9.6m). Exclusive use for experimental work.

2. Kinematics

   (a) TV-computer (after Strathclyde). A special-purpose interface to link up to seven TV cameras to a PDP-11 computer. Resolution is 0.3% vertical and 0.1% horizontal for each camera. Selectable sample rates at 50 Hz and submultiples.

   (b) 16mm cine cameras driven by synchronous motors at fifty frames per second. Manual reduction with resolution of approximately 0.2% horizontally and vertically. (System being phased out.)

   (c) Accelerometer platforms allowing full kinematic analysis of pelvis or other spinal sites. Special-purpose transducers 5g full-scale, < 10μg noise and drift. Spatial system resolution not yet determined.

3. External Forces

   Ground reaction: two Kistler force plates set into the floor, each measuring six force components. Also two parallel, vertical reaction walkways for consecutive paces, 3m long.

4. Recording

   Racal 7-channel IRIG FM tape recorder.

Oxford cont.

5. Data Reduction

L-W analyzing projector
D-Mac Digitizer tablet (resolution 0.01 inch).

6. Analytical

PDP-11/34 with 32k memory
2 cartridge disc drives
16-channel, 10-bit analog-digital converter, 30k word/sec.
Graphics visual display
X-Y plotter
Direct memory access TV interface >50 word/sec. buffered onto disc memory.

II. PARAMETERS

Both limbs recorded singly or simultaneously
Motions: Linear: Stride length, cadence, swing and stance, velocity, gait width
Spatial Relations: Joints and body segments
Angular: Hip, knee, ankle, foot in sagittal and coronal planes
Forces: Ground Reaction: Vertical
Joints: In vitro, hip and knee compression

Processing - Manual, Motion Analyzer, Computer

Sampling rates: 10m/s accelerometers
50 and 20 fps cine
Time: Walkway: instant
Accelerometer: 2 hours
Cine: 7 days

III. PHILOSOPHY

Briefly the purposes are:

1. To investigate mechanical factors in locomotor disability, with a view to providing general guidance to orthopaedic treatments, rather than to assess individual patients. In particular, there is interest in the effect of different sequences of partial treatments for diseases with multiple foci in the lower limbs, best exemplified by rheumatoid arthritis. This work should lead to a structured description of a range of disease and treatment combinations, with their likely consequences.

2. To evaluate the mechanical effects of traditional and new orthoses. Again, the purpose is related to the orthosis/disease combination and not to the individual patient. It is recognized, however, that valid evaluations of orthoses will not be possible until the disability that they are used to treat is properly described.

The center has also considered the locomotor system as a physical experiment, and have concluded that:

1. The range of physical variables which can usefully be measured is quite limited. They are external forces (as applied to the ground), loads in structures worn or carried (as in an orthosis), external kinematic quantities, and electromyograms. The measurement systems were chosen to allow these variables to be measured in as generalized and flexible a way as is presently possible.

2. None of the above variables is suited to direct interpretation. For the analyses of locomotion being made, processing and careful representation are required. The use of a computer for this purpose is essential.

3. With the correct choice of measurement and analytical equipment, it is possible to set up a gait laboratory which will allow most locomotor analysis problems to be solved. The initial cost may be quite high, both in terms of equipment and preparation, but the benefits come in the relative ease with which experiments can be modified to suit the current problem.

IV. PROJECTS

1. Analysis of the effects of rheumatoid arthritis and osteoarthritis on the kinematics of the knee joint. This work has been completed for angular movements in the sagittal plane. It is being extended to consider frontal plane movements also. Detailed work is carried out by engineering research students. One has recently completed his studies and left, and another is recently started.

2. A study of knee joint instability caused by soft tissue injury in the knee. This project is just beginning and is to be carried out by an orthopaedic research student. An interesting feature is an attempt to improve the accuracy of kinematic measurements by radiographic studies of the relative movement between skin markers and the skeleton.

3. Movements of the pelvis will be measured by an accelerometric scheme which has been gradually developed here over the last seven years. The current project occupies one engineering research student who has been working for about one and one-half years developing new transducers and analytical software. The purpose of the project is to examine the role of spinal movements in compensating for joint dysfunction in the lower limbs.

4. A project which is an exception to the philosophy of using general-purpose measurements is the development of a foot-switch and timer system using Spherax (Pressex), as originally proposed by the Rancho Los Amigos Hospital, California. This instrument will be used for gait retraining. This work is done by a Research Assistant.

Proposed projects which have yet to begin are largely indicated in the paragraphs above on the philosophy of the center.

VI. OTHER GROUPS INVOLVED IN GAIT STUDIES

Professor G. Murdoch
Limb and Appliance Center
133 Queen Street
Broughty Ferry
Dundee, Scotland

Mr. Gunar Holmgren
Een-Holmgren Ortopad A.B.
Bergsbrunnagat 1,
Uppsala 75323
Sweden

Mr. G. Veres
National College of Prosthetics
Sophies Minde Orthopaedic Hospital
Trondheimsveien 132
Oslo 5
Norway

Dr. E.H. Furnee
Technische Hogeschool Delft
Laboratorium voor Technische Natuurkunde
Lorentzweg 1
Delft
Nederland

Professor U. Boenick
Technical University of Berlin
Berlin
Germany

Note: The author acknowledges Dr. J.P. Paul who brought these names to his attention. Regretfully, time did not permit the opportunity to gather information from them for this report.