NEWSLETTER NUMBER 9

JANUARY, 1980

FORCE PLATFORM GROUP

INTERNATIONAL SOCIETY OF BIOMECHANICS

Group Chairperson — Howard Payne
Department of Physical Education,
University of Birmingham,
P.O. Box 363,
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England.

Newsletter Edited by — Barry D. Wilson (Secretary)
Department of Human Movement Studies,
University of Queensland,
St. Lucia,
Brisbane,
Australia. 4067.

(The Newsletter is circulated free to members of the Force Platform Group. Membership enquiries to the Secretary).

Contents

THE FORCE PLATFORM GROUP OF THE I.S.B.

The Group first formed in 1973 at the Fourth International Seminar on Biomechanics at the Pennsylvania State University, U.S.A. with an ad hoc committee of Peter Cavanagh (U.S.A.) and Don Grieve (England). Howard Payne (England) became 'catalogue editor' and produced two editions of "A catalogue of force platforms used in biomechanics research".

At the 1977 Sixth International Congress of Biomechanics at the August Krogh Institute, Copenhagen, Denmark, the Group re-formed itself, and elected Howard Payne as chairperson with Barry Wilson as secretary.

A biannual newsletter is produced by the Group and is sent to all members, who are asked to pay a US $6 subscription to cover the costs of producing and mailing the newsletter.

The biannual newsletter was initiated with the following objectives:

(a) To provide a bibliographic service to Group members on a regular basis.

(b) To publish original articles on topics related to force measurement in human biomechanics.

(c) To provide a forum for questions and answers on related subjects.

In this 'Message' in the Newsletter No. 1 the Chairperson urged: "Firstly, please let the editor of the newsletter have any ideas that you might generate concerning material to be included in future editions. The newsletter is a far stronger means of communication than one meeting of the Group every two years, and in such a small group, we shall need input from almost every member. Secondly, if you are aware of force platform users who are not members of our group, please encourage them to get in touch with us so that we can benefit from their input".

Editor's Note

Beginning in 1980 the F.P.G. accounts will be prepared for the financial year July 1st to June 30th so that account preparation will coincide with biennial meetings of the F.P.G. The accounts will continue to be presented in the January issue of the Newsletter. This should reduce the work load of the Hon. Secretary/Treasurer/Editor!

Back issues (Xerox copies) of the Newsletters 1-8 are available at a cost of $2.00 per issue. Airmail delivery from Australia is an additional $2.00 per order (delivery time would be approximately 1 month from receipt of order).

A number of letters have been received. Details of these are included in the "Additions to the Force Platform Register" and in the "Additions to the Bibliography".

More contributions to the Newsletter are invited. Papers should be submitted in a form suitable for publication with a maximum of 8 pages, in English, typed double space with art work as black on white line drawings or photographic prints of black on white drawings of 3½" x 5" size.

Details concerning (1) the problem, (2) the platform, (3) the peripherals, and (4) how the platform can aid in solving the problem, would be appropriate for submission. Editorial changes will be minimal and should not require correspondence between the author and editor before publication. Papers should be submitted to the Newsletter editor by December 1 and June 1 for the January and July Newsletters respectively.

Finally, to those persons who have contributed to this Newsletter, thank you.

Barry D. Wilson.

FORCE PLATFORM GROUP

INTERNATIONAL SOCIETY OF BIOMECHANICS

SECRETARY'S REPORT FOR GENERAL MEETING, SEPTEMBER, 1979.

MEMBERSHIP

Paid up members, 1978	92
Paid up members, 1979	94

13 members have subscriptions in arrears

NEWSLETTERS

Four Newsletters have been sent out since the last General Meeting 1977. The circulation during 1978, 1979 has been approximately 110 copies/issue. Complimentary copies were issued to libraries (9). The January Newsletter has been sent to persons in arrears for that year, together with a request for payment of arrears. If arrears are not forthcoming by July of that year then no further Newsletters are sent.

Back issues (xerox copies of Newsletters 1-5) are available at a cost of $2.00/issue. Air mail delivery is an additional $2.00/order.

FINANCE

Please see separate balance sheets. One year subscriptions and cheques in currency other than U.S. or Australian dollars are most uneconomical. Exchange and bank charges can result in a $5.00 subscription being credited at < $3.00 Australian. It is suggested that subscriptions be increased to $US6/year, that these be paid in two (2) year units in U.S. currency or currency of the Secretary/Treasurer's country.

CONCLUSION

The increasing membership from 53 in 1977 to 94 in 1979 demonstrates that the Force Platform Group is a viable special interest group and that the Newsletter serves a useful purpose in informing members of new developments in the field of force measurement.

Barry D. Wilson.

SECRETARY/TREASURER'S REPORT

F.P.G. INCOME AND EXPENDITURE ACCOUNT

FOR PERIOD ENDED JULY, 1979

(Covering Issues of Newsletters 7 and 8)

	$
Membership subscriptions nett of currency exchange and bank charges	46.00
Carried forward from Dec. 1978	356.69
	402.69
Bank account balances 31/7/79	224.00

	Costs	Payments
Printing of Newsletter No. 7	203.55	90.00
Postal charges Newsletter No. 7	55.70	55.70
Printing of Newsletter No. 8	125.67	32.99
Postal charges Newsletter No. 8	67.65	-
	452.57	178.69
Debts outstanding		273.88
		452.57
Excess of expenditure over income		- 49.88
		402.69

NOTES

(1) Exchange rates fluctuated around $A1.00 = $US1.12

(2) The F.P.G. has bank accounts in both the U.S.A. and Australia.

Barry D. Wilson.

1980

Projected Income		Projected Expenditures	
Cash held for Banking	26.00	Newsletters 9 and 10	450.00
Subscriptions (13 in arrears 1979) 10 @ 5	50.00	Debit balance 1979	50.00
(64 due in 1980) 60 x 5	300.00		500.00
	376.00		

(Note: Not including sale of back issues)

∴ Need to increase subscriptions to $6.00/annum.

Barry D. Wilson.

FORCE PLATFORM GROUP
INTERNATIONAL SOCIETY OF BIOMECHANICS
MINUTES OF BIENNIAL GENERAL MEETING, SEPT. 21, 1979
WARSAW, POLAND.

Present

H. Seidel	East Germany
J. Olszewski	Poland
J. Denoth	Switzerland
H. Gros	Canada
C. Bosco	Finland
A. Sidorczuk	Poland
P. Procter	Great Britain
A. Toshio	Japan
G. Gautschi	Switzerland
K. Nicol	Germany
K. Watanabe	Japan
P. Tveit	Norway
B. Wilson	Australia
S. Kume	Japan
U. Kiyomi	Japan
Y. Ikegami	Japan

1. Apologies

Apologies for the abscence of Howard Payne were noted. Barry Wilson assumed the role of the chair for the meeting.

2. Minutes of Biennial General Meeting, 12 July, 1977

Accepted

3. Matters arising from minutes

Nil.

4. Secretary's Report

The accounts, balance sheets and secretary's report were presented and accepted.

A motion of thanks to the secretary was proposed from the floor and carried.

5. Chairperson's Report

Not available at the time of the meeting.

6. Role of Elected Offices

Barry Wilson stated that the election of persons to positions where their role was not clearly defined should be discontinued. Discussion followed with particular reference to the Bibliographers. Barry Wilson offered to define the role of the Bibliographers and Technical Liaison Officer.

7. Election of Officers

The following were elected.

Chairman: Howard Payne

Secretary/Treasurer/Editor/Bibliographer: Barry Wilson

No nominations were called for the positions of Bibliographers or Technical Liaison Officer.

8. Proposed Increase in Subscription

The accounts for 1979 and the projected deficit budget for 1980 were presented.

The following discussion supported the suggested increase in dues to $US6/year.

A motion to increase dues to $6/year was put and accepted. A motion that consideration be given dues being collected by the I.S.B. secretariat was put and accepted.

Following a vote of confidence in the Newsletter Editor the meeting closed.

Barry D. Wilson.

ADDITIONS TO THE FORCE PLATFORM REGISTER

M. Lamontague
University of Montreal
Montreal, Quebec,
Canada. H4J 1J6.

Own design 660 x 660 mm
Strain gauges

Visicorder

Cameras

Sports Technique

Dr. M. Mussen
Ruksuniversiteit - Gent
Fysiotherapie en Orthopedie
9000 Gent
De Pintelaan 135

2 Kistler platforms

24 channel polymyograph

Pathological condition of the locomotor system.

Dr. R. Ortengren
Department of Clinical Neurophysiology
Sahlgren Hospital
S-41345 Goteborg
Sweden.

L'Electronique Appliquée 420 x 420 mm
Differential transformers

On line to PDP-15 computer

Scoliosis research.

Dr. M.W. Whittle
Oxford Orthopaedic Engineering Centre
Nuffield Orthopaedic Centre
Headington, Oxford OX3 7LD
ENGLAND.

2 Kistler platforms 400 x 600 mm
A/D Interface to PDP 11/34 computer

2 University of Surry 460 x 2150 mm Vertical Reaction Force Plates
1 Rancot 'Footprint' vertical force distribution plate

3 D T.V./computer system

Hip and knee injury and orthoses assessments.

ADDITIONS TO THE BIBLIOGRAPHY

Sahlstrand, T., Petrusson, B. and Ortengren, R. 1977. Vestibulospinal Reflex Activity in Patients with Adolescent Idiopathic Scoliosis. In Equilibrium Factors in Adolescent Idiopathic Scoliosis, by T. Sahlstrand, Göteborgs University, Göteborg, Sweden.

Sahlstrand, T., Örtengren, R. and Nachemson, A. 1978. Postural Equilibrium in Adolescent Idiopathic Scoliosis. Acta Orthop. Scand., 49, 354-365.

CANADIAN SOCIETY FOR BIOMECHANICS (CSB)
SOCIETE CANADIENNE DE BIOMECANIQUE (SCB)

Special Conference - London, Ontario, October 27-29, 1980
Human Locomotion "Pathological Gait to the Elite Athlete"

The Canadian Society of Biomechanics has organized a special conference on "*HUMAN LOCOMOTION - Pathological Gait to the Elite Athlete*". The meeting will be held at the University of Western Ontario, London, between the 27th and 29th of October, 1980.

This special conference is designed to bring together Practitioners and Researchers to exchange findings and to identify and resolve important issues in Human Locomotion. The conference will be held of interest to Biomechanics Researchers, Therapists, Kinesiologists, Rehabilitation Engineers, Orthopaedic Surgeons and Specialists in Rehabilitation, Sports and Physical Medicine.

For further information and author's kit, please contact:

Dr. Malcolm Peat
Program in Physical Therapy
B-RE 28 University Hospital
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LONDON, Ontario N6G 2K3

Would any person having a forwarding address for:

Dr. Patricia Downie
54 Prospect
Northampton
Massachusetts 01060
U.S.A.

please contact the F.P.G. secretary.

An Instrumented Treadmill for Clinical Measurement of Ground Reaction Forces

by

Erik C. Jansen, MD
University of Copenhagen, Hellerup, Denmark.

In the clinical study of gait, information is needed on long lasting gait, gait on tilting surface, and gait at different speeds. To meet these needs an instrumented treadmill is constructed. The treadmill registers the continuous ground reaction forces of each foot.

Initial concept of the treadmill: Knud Jansen, Dr.Med.Sc., assoc. professor of orthopedic surgery and head of department, Gentofte Hospital.

Vagn Aage Jeppesen+

Dr.Eng.Sc., professor, head of Department of Mechanical Technology, the Technical University of Denmark.

Construction 1969 - 1971: Henrik Stahl, M.Eng.Sc., now assistant professor, Eskild Tjalve, M.Eng.Sc., now assistant professor, Department of Mechanical Technology, the Technical University of Denmark.

Instrumentation and revision of construction: Biomechanical Laboratory.

Computer programming and systems: Biomechanical Laboratory and the EDP department of the Outer Copenhagen Hospital Administration.

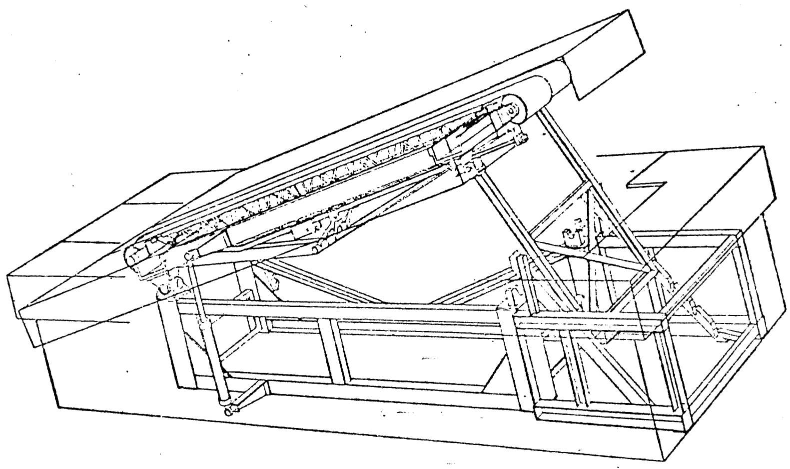


Figure 1. The Design of the Treadmill

The instrumented treadmill combine the unlimited gait length of the treadmill and the ground reaction force measurements of the force plate.

The area for gait measurement is an area of 2050 mm in length and 600 mm in width.

On each force plate the top layer consists of a wood/aluminium/wood plate supported by an aluminium framework. In each corner is situated totally four vertical transducers. In the two ends are located two transducers measuring the medial/lateral forces, and one transducer measures the anterior/posterior force. All transducers are suspended in rod and ball constructions permitting no oblique forces. The transducers are of resistive strain gauge type.

The treadmill function is maintained by two PVC/nylon conveyor bands encircling each of the force plates. Rollers in each of the ends provide the steering and propulsion of the conveyor bands. The conveyor bands are sliding on the measuring surface of the force plates. Each of the conveyor bands are driven by hydraulic power engines. The engines are mounted "floating" on rollers, and a spring and roller system secures that the turning moments of the engines do not interfere with the force plate measurements.

The total treadmill system is resting on an outer iron frame which may be tilted frontally in steps of 5 degrees up to 30 degrees or sidewards in steps of 2½ degrees up to 12½ degrees. The tilting is performed by hydraulic power.

A base frame is situated in a concrete grave. The base frame is anchored in concrete to avoid oscillations of the construction.

The walkway is on the level of the surrounding floor of the gait laboratory.

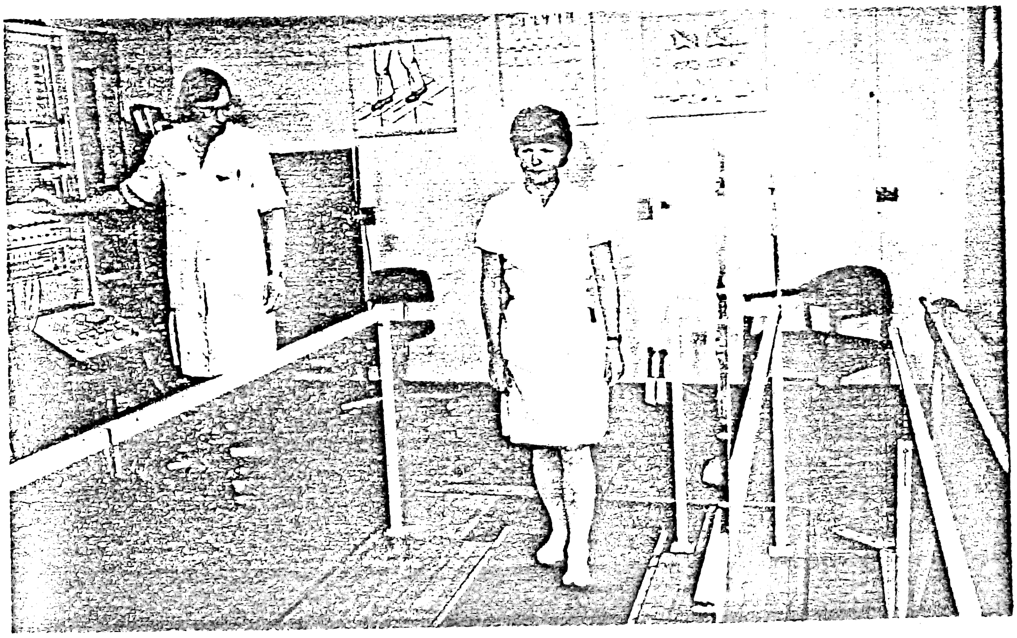


Figure 2. Gait Analysis on the Instrumented Treadmill.

The signals of the totally fourteen transducers are amplified and summarized, providing a three-dimensional vector system for each foot.

A code unit supply the recording with identification and information of the test situation.

The measurements can be written immediately on an UV-recorder and stored on a Lyrec TR-86 eight track f.m. tape recorder.

For evaluation and concentration of the findings an IBM 1800 computer has been used since 1974. Recently on line processing is made available by a Digital PDP 11/10 computer.

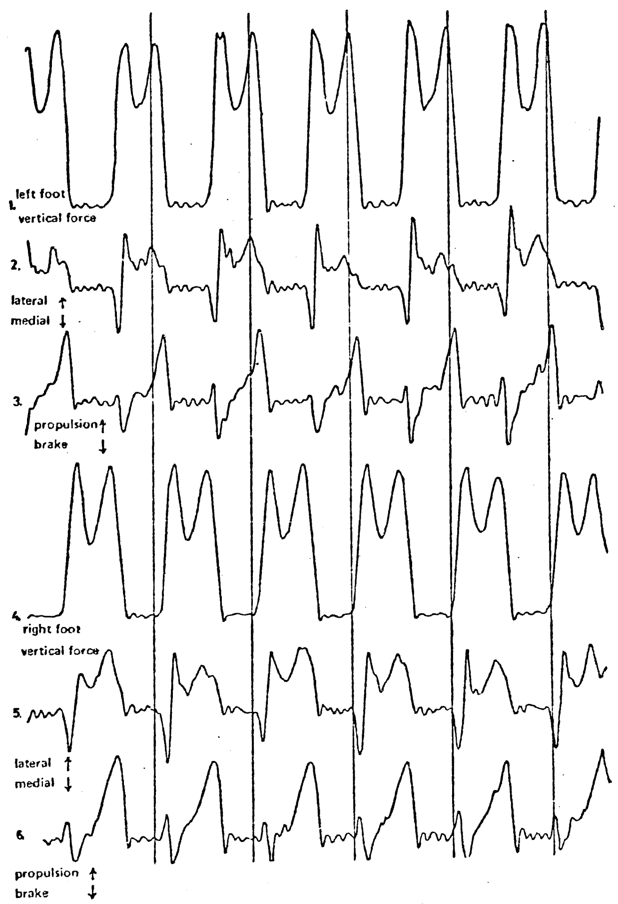


Figure 3. The Continuous Gait Curves.

Specifications: height 911 mm; overall length 3620 mm; overall width 1640 mm. Effective area of measurement 2050 mm x 602 mm. Maximum effective propulsion speed 5.6 km/h in two directions. Weight of one force plate 19.7 kg. Total weight of the treadmill 764 kg. Lowest point of resonance with a static load of 55 kp: 21 Hz.

Transducers on each force plate:

Hottinger Baldwin Messtechnik

vertical: 4 ps. type C2/500 kp

medial/lateral: 2 ps. type U2/200 kp

anterior/posterior: 1 ps. type U2/500 kp.

Amplifier: summation amplifier with an active low pass filter with a cutt off frequency of 12 Hz. Output aberration from linear response to increasing load on the treadmill ≤ 3.2%.

Clinical implementation: the gait laboratory is located nearby the clinical wards at the Gentofte Hospital. More than 1500 gait tests have been performed.

Bibliography

1. Erik Jansen. Computer analysis of the gait pattern - preliminary report. Proceedings of Combined Meeting of Orthopedics, Nijmegen, Holland. September 1974, pp. 85-87.

2. Erik Jansen and Knud Jansen. Constancy of gait. Proceedings of IV Nordic Meeting on Medical and Biological Engineering, 1977, pp. 82-86.

3. Erik Jansen, Knud Jansen and Jens E. Pedersen. Quantification of ataxia. Strathclyde Seminars Proceedings 1978, Oxford University Press (In press).

4. Erik Jansen. An instrumented treadmill - a system for continuous registration of the foot to ground forces. Acta Orthopaedica Scandinavica, submitted for publication 1979.

5. Erik Jansen and Knud Jansen. Vis - Velocitas - Via, alterations of foot to ground forces during increasing speed of gait. Biomechanics VI-A, Baltimore, 1978, pp. 267-271.

Force Platforms: Their Use in Human Movement Studies

by

Barry D. Wilson
University of Queensland, Brisbane, Australia.

My involvement with the use of force platforms may be said to be relatively recent. In 1974 as a Research Assistant at the University of Iowa, I was employed to design and have built a force platform for motion studies. At this time I became aware of 2 editions (1973 and 1974) of "A catalogue of force platforms used in Biomechanics research".[4] This catalogue, and updates to the catalogue, contain details of over 200 platforms and recording systems presently in use throughout the world.

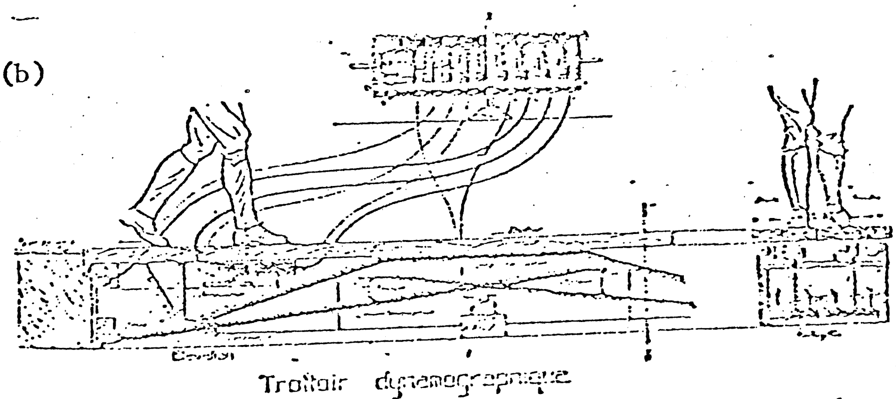
Essentially, a force platform is a device designed to measure the forces exerted by the body on an external surface - the force platform. In Australia there are presently 5 Labs with force platforms and appropriate recording systems. Several more are being built or purchased at this time.

J.P. Paul in the recent text "Technique for the analysis of Human Movement" describes 5 types of platforms: Large area force platforms where two foot contact is measured; A two track dynamometer system with a walkway and one track for each foot; A single step dynamometer where the platform size dictates that only single step contact is possible; Special footwear where a dynamometer is attached to or built into the footwear; A prothesis dynamometer with the dynamometer built into the prothesis.[3] I would not adopt such a limited definition of platform type but would prefer to state that - the particular type of force platform, that is the size and construction and characteristics of the platform, depends on the intended use of the platform.

Some early attempts at platform design and direct measurement of forces generated during movement are shown in Figure 1 a, b, c.

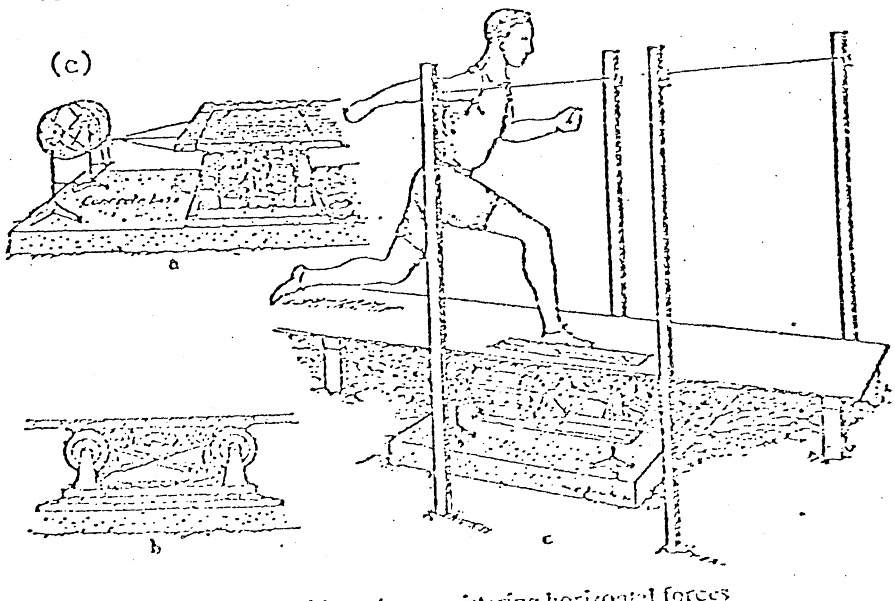
Running man carrying recorder for recording pressure on the ground and vertical acceleration of the head.

(b)



Force platform with rubber balls registering vertical and horizontal forces

(c)



Force platform with springs registering horizontal forces

Force Platform Designs

The components of the basic measuring system may be described as -

1. A transducer - a device which converts mechanical force into another measurable form.

2. An amplifier - a device which increases the magnitude of the detectable change in state of the transducer, to facilitate ease of reproduction.

3. A display - provides a convenient representation of the force, usually in a form which allows measurement to be made.

Commercially available force platform systems have the capability to measure (a) Three orthogonal force components and (b) the point of application of the applied force on the surface of the platform, as well as, (c) the moment of the applied force about the axis perpendicular to the surface of the platform. Platforms with these capabilities range in price from $10,000 upwards.

Some examples of non-commercial force plate designs can be seen in Figures 2 and 3. The large differences in the designs shown represent the designers emphasis in overcoming problems inherent in the design of force platform systems.

Figure 2 A non-commercial force plate design (from Judge, G., International Society of Biomechanics Force Platform Group Newsletter 3, 1977)

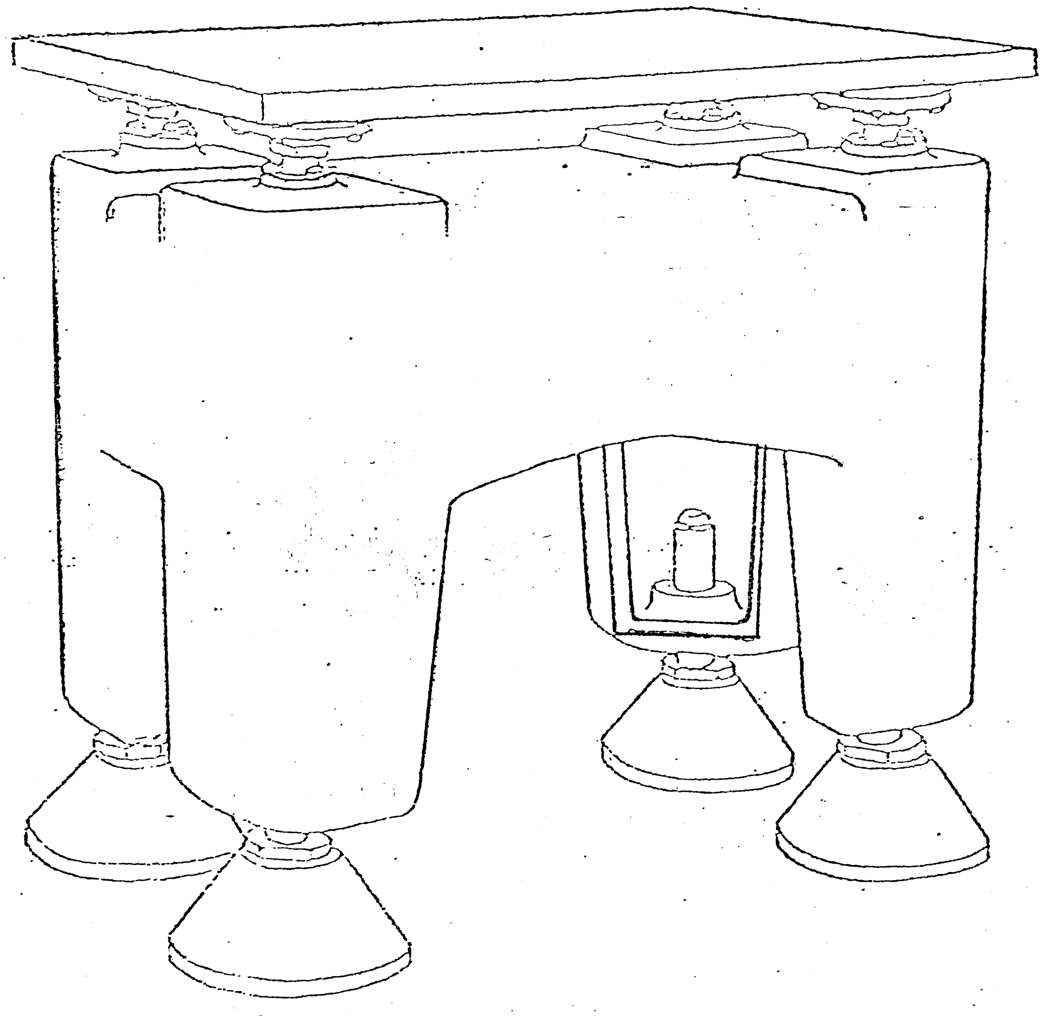
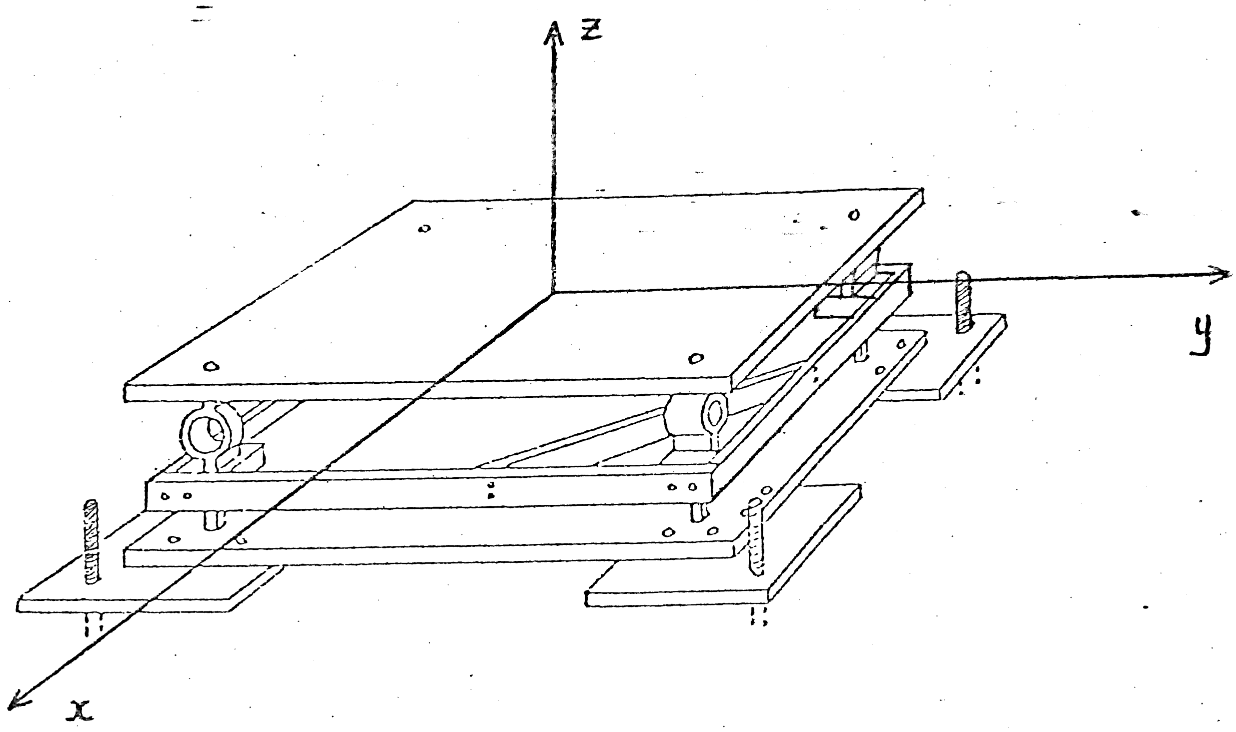


Figure 3 A non-commercial force plate design (from Wilson B.D. International Society of Biomechanics Force Platform Group Newsletter 8, 1979)[5]

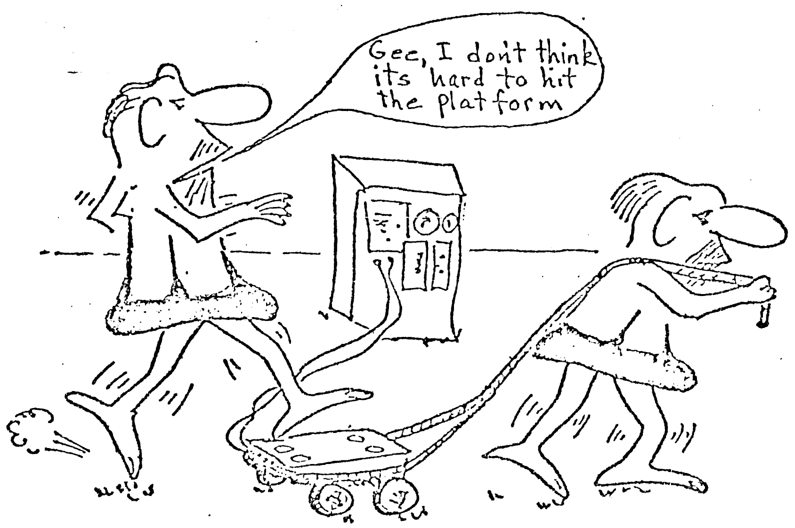


Considerations Regarding Recording Techniques

In any application it is important that the placement of the force measuring device does not interfere with the subject's natural movements. For example, a subject may be so conscious of the need to make foot contact with a force platform that he alters his normal gait pattern to ensure that this occurs (a phenomenon called "targetting"). There are many ways of overcoming this problem (see Figure 4). A more normal method would be to include practice trials for the subjects.

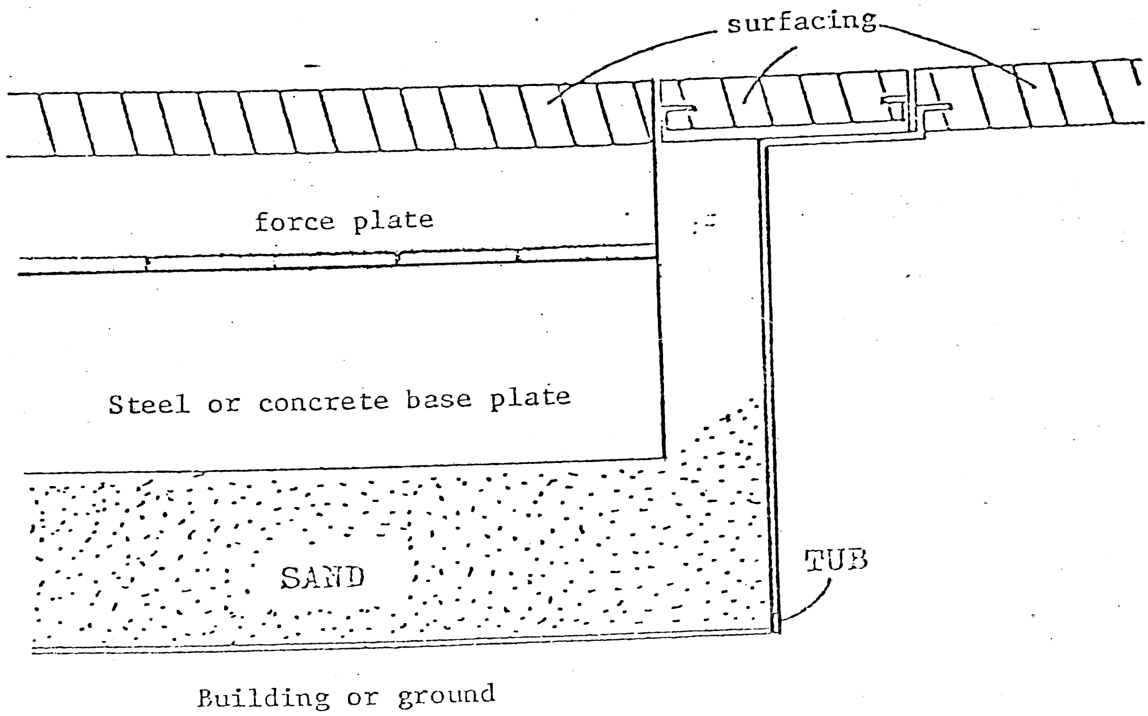
Figure 4 The problem of "targetting".

Submitted by: Barry T. Bates, Ph.D. and Donald McIntyre, Biomechanics/Sports Medicine Laboratory, Department of Physical Education, University of Oregon, Eugene, Oregon, 97403, USA



The device must also be mounted in a manner that provides accurate measurements to be made in the directions of motion of interest to the investigator. Because extraneous forces might be detected, care must be taken to ensure that these effects are eliminated. One of the major sources of extraneous noise is that due to mounting - building or floor vibrations. A method overcoming this is shown in Figure 5.

Figure 5 A method used to overcome noise due to building or floor vibrations.



Any measuring system should faithfully reproduce the full character of the force of interest, yet be largely insensitive to extraneous effects, as distortion of the waveform of a rapidly changing force can lead to serious misinterpretations.

The transducer should be of a suitable type and size to be easily located as close as possible to the region of force application. It should have adequate sensitivity, frequency response, and detection range to provide a valid measure of the force of interest. Similarly the amplifier's stability, linearity, bandwidth and gain should be adequate to ensure faithful processing of the transducer signal. These characteristics are dictated by the nature of the signal to be recorded.

What then is the nature of the force signals to be recorded? The magnitude of the forces associated with human movement vary widely, ranging from values less than 100 Newtons in the case of weak muscular contractions to several thousands of Newtons in the instance of ground reaction forces. Further, frequency content of muscular contractions may be no greater than 10Hz, whereas forces arising from sudden impacts may have components in the vicinity of 1000Hz. The time course of forces associated with human movements is quite variable, ranging from a few milliseconds for ball impacts, through hundreds of milliseconds for ground reaction forces, to several seconds or minutes in the case of quasi-static forces associated with balance or holding situations. The low-frequency response capability of the system warrants mention, particularly as some force transducers are of the capacititive type whose output under static loading decays with time.

The display instrument adopted will be determined largely by the phenomenon recorded. For static measures a digital read-out may suffice. Where, however, the full-time history of a dynamic force is required, either analogue displays (storage oscilloscope, chart recorder), or storage (magnetic tape), or on-line analogue to digital (A-D) conversion must be available. The minimum sampling rate in the AD conversion must be at least twice the highest frequency contained in the force signal (Nyquist rule).

For valid and repeatable force measurement the system must also be amenable to calibration throughout the measurement range; ideally, both statically and dynamically. The degree of insensitivity of the system to extraneous sources of signal such as "cross-talk" between recording channels should also be verified. As with frequency response assessments all components of the measuring system should be calibrated simultaneously.

The recorded signal should be free of interference which may arise from a number of sources, such as; transducer mountings, electrical inductance, temperature and humidity variations, cable aberrations.

Any communication of research findings should always include evidence of the purity of the signal recorded, together with precise details of equipment performance specifications, calibration procedures, and testing protocol.

Applications

Typical applications of force platforms might include measurement of:

(a) Ground Reaction Forces

1. Stabiliography
2. in walking or running, i.e., locomotion
3. sprint starts

(b) Transmission of forces between a subject and some piece of equipment

1. ergonomics
2. gymnastics equipment

(c) Transmission of forces between some piece of equipment and the external environment

1. impact forces on cricket bats - helmets
2. forces in hammering, sawing or drilling

(d) Forces induced to act on materials

1. as in evaluation of the mechanical properties of tissues
2. evaluation of equipment - flexibility of vaulting poles as a function of body weight

(e) Invasive measurement of forces

1. internally placed pressure transducers
2. forces acting on and through prosthetic devices

(f) Measurement of strength

A number of different types of transducers are used to assess strength - isometric, isotonic, isokinetic.

In contrast to these applications and measures of forces external to the body, force records may be used to analyse internal parameters describing motion such as resultant forces and torques at joints in the body, or forces within particular muscles or ligaments in the body.

The description of internal parameters of motion is a complex task requiring (a) a description of the kinematics of the motion - that is how far and how fast has the body and its limb segments have translated and rotated, and (b) a description of the characteristics of the human body itself - that is masses, moments of inertia and centre of gravity locations of the body segments, and (c) a knowledge of muscle and ligament attachment sites and dimensions.

The complexity of the analysis of forces and torques internal to the human body has meant that most applications of force platforms are concerned with relating the forces exerted by the subject on the platform to a force record associated with an optimal technique of movement.

Acknowledgements

In the preparation of this manuscript the author wishes to acknowledge the use of materials from the "Application Notes - force measurement", prepared by the Australian National Sports Biomechanics Study Group. (B.D. Wilson - Coordinator).

This paper was presented at the American Sport Medicine Federation - Society for Medical and Biological Engineers, held in Brisbane, 15th-16th November, 1979.

References

1. Assmussen, E. Movement of man and study of man in motion: a scanning review of the development of biomechanics, pp. 23 - 40. In Biomechanics V-A, P.V. Komi, ed., University Park Press, Baltimore, 1976.

2. Judge, G. A force plate in use at the Department of Health and Social Security - London. International Society of Biomechanics Force Platform Group Newsletter 3, 18-25, 1977.

3. Paul, J.P. Instruments for force measurement, pp. 151-171. In Techniques for the analysis of human movement, Grieve, D.W., Miller, D., Mitchelson, D., Paul, J., and A.J. Smith. Lepus Books, London, 1975.

4. Payne, A.H. "A catalogue of force platforms used in biomechanics research". Department of Physical Education, University of Birmingham, 1973, 1974.

5. Wilson, B.D. Outline of a force plate design. International Society of Biomechanics Force Platform Group Newsletter 2, 15-20, 1976.

THE FORCE PLATFORM GROUP

INTERNATIONAL SOCIETY OF BIOMECHANICS

SUBSCRIPTIONS

Please complete and return this form with U.S.$6 (or equivalent), being subscription fee for 1980, to Barry Wilson.

Department of Human Movement Studies,
University of Queensland,
St. Lucia,
Brisbane,
Australia 4067.

If you wish you may send U.S.$12 for 1980 and 1981.

Name: ______________________________

Address: ______________________________

____

____

____

Amount enclosed: ______________________________

Please make cheques payable to Barry Wilson, Force Platform Group, International Society of Biomechanics.

Force Platform Group. I.S.B.,
C/o Dept. of Human Movement Studies,
University of Queensland,
St. Lucia, Brisbane, 4067,
Australia.

Dear Colleague,

In the 4th Newsletter was included a register, or list of members and their research interests. In order to update this register would you allow me to publish brief details of your work. Please complete the questionnaire below and return to me as soon as possible:

1) Name ____

2) Title (Mr., Mrs., Ms., Dr., Prof., etc.)____________________

3) Address ____

____

____

4) Institution (if different to above) ____________________________

____

____

5) Do you work with a force platform? Yes ______ No________

6) If answer is NO please give reasons for your interest:-

____

____

7) Please give brief details of your platform or platforms

Type ______________________________

Transducers ______________________________

Size of top surface ______________________

Recorder ______________________________

Other ______________________________

8) What auxiliary equipment do you use? (e.g. E.M.G., cameras, etc.)

____

9) What are the main lines of your research? (e.g. sports techniques, gait analysis, etc.) ______________________________

10) Please list any relevant publications by you which have not been included in Newsletters 1 and 2. (Attach additional sheets if necessary)

____

____

____

Many thanks for your co-operation.

Barry D. Wilson,

Secretary, F.P.G.