

# Development of non-invasive and ambulatory monitoring system for cardiovascular haemodynamic parameters inclusive of cardiac output and blood pressure

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# 1995 Fiscal Year Final Research Report Summary

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Development of non-invasive and ambulatory monitoring system for cardiovascular haemodynamic parameters inclusive of cardiac output and blood pressure

Research Project

## Project/Area Number

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05555107

## Research Category

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Grant-in-Aid for Developmental Scientific Research (B)

## Allocation Type

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Single-year Grants

## Research Field

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計測・制御工学

## Research Institution

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Kanazawa University (1994-1995)  
Hokkaido University (1993)

## Principal Investigator

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## Project Period (FY)

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1993 – 1995

## Keywords

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Non-invasive and ambulatory physiological measurement / Electrical admittance cardiography / Volume-oscillometric method / Cardiovascular haemodynamic variables / Human posture / Portable instrument / Cardiovascular function during daily activity / Home health care

## Research Abstract

In recognition of the increasing need for health maintenance and disease prevention, an attempt was made to develop a non-invasive and ambulatory system capable of monitoring various cardiovascular parameters, naturally including cardiac output and blood pressure, during daily activities in a fully automatic manner. It is based on the electrical admittance cardiography and the volume-oscillometric method. The system mainly consists of (i) a finger cuff with a photo-plethysmographic sensor for detecting blood volume changes and tetra-polar electrodes for detecting the bio-admittance signal, (ii) a portable unit (104x64x32mm, 160g) which allows necessary measuring procedures and control, together with signal processing and data storage in a CMOS RAM, using a single-chip microcomputer, and (iii) data reproducing and analysing unit using a personal computer system. A subject carries the former two during monitoring. Long-term monitoring is made with a desired interval of 2, 5 and 10 min preset, and after the monitoring the stored data are reproduced and analyzed by the computer, being displayed pulse rate (HR), pulse interval (PI), systolic (SBP)/mean (MBP)/diastolic pressure (DBP), ventricular ejection time (Ts), stroke volume (SV), cardiac output (CO=HR · SV), peripheral vascular resistance (Rp=MBP/CO) and rate pressure product (RPP=HR · SBP) as an index of cardiac oxygen consumption in a trend manner. Besides the development of this system, a portable instrument for long-term ambulatory monitoring of human posture change has been designed, taking physiological importance and usefulness of such information along with cardiovascular haemodynamic parameters into consideration. It is based on the fact that almost all human postures in daily life, e. g. standing, sitting, lying, walking etc., can be estimated from the angles corresponding to the gravitational direction in three portions; chest, thigh and lower leg. The instrument (58x94x25mm, 130g) includes preamplifiers, an A/D converter (6bit; sampling interval, 0.1, 0.2, 0.5, 1s), and a CMOS RAM (2MB) for storing the angles from electro-magnetic inclinometers placed on the three portions. Performance, availability and stability for monitoring by these two systems have been tested with successful and satisfactory results. Lots of 24-hour monitorings and data analyzes regarding the interactive relation among the cardiovascular variables and the periodic construction of their circadian fluctuations using the maximum entropy method (MEM) have also been successfully made, suggesting that each proposed system appears promising as a method for use not only in further advanced basic and clinical cardiovascular researches but also in case of self care at home. ▲ Less

## Research Products (27 results)

All Other

All Publications (27 results)

- [Publications] 五十嵐 朗 他: "血圧・血液酸素飽和度の在宅計測" 信学技報. MBE93-47. 71-74 (1993) ▼
- [Publications] 沢田 幸展 他: "ストレス刺激負荷時の血行動態に関する無侵襲計測と自律神経系調節機能の解析" 生体・生理工学シンポジウム論文集. 8. 257-262 (1993) ▼
- [Publications] 山越憲一 他: "血圧・心拍出量を含む無拘束循環動態モニタシステムの開発と応用" 医用電子と生体工学. 32. 444 (1994) ▼
- [Publications] Yamakoshi, K. et al: "A new automated portable system for ambulatory measurement of cardiovascular haemodynamic parameters" Med.& Biol.Eng.& Comput.32. 757 (1994) ▼
- [Publications] 中川原 実 他: "無拘束循環動態長時間計測システム" 臨床モニター. 5. 102-103 (1994) ▼
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- [Publications] 山越憲一(分担執筆): "アドバンスト・センサハンドブック" 培風館, 763 (1994) ▼

- [Publications] Ikarashi, A.et al: "Measurement of arterial blood pressure and blood oxygenation for home care use" Tech. Rept.MBE93-49. 71-74 (1993) ▼
- [Publications] Sawada, Y.et al: "Noninvasive measurement of hemodynamic responses during stressful stimulations and an analysis of autonomic regulation" Proc. Biol. & Physiol. Eng.8. 257-262 (1993) ▼
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