PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61B 5/0476

A1

(11) International Publication Number: **WO 00/44279**

(43) International Publication Date: 3 August 2000 (03.08.00)

(21) International Application Number: PCT/GB00/00204

(22) International Filing Date: 27 January 2000 (27.01.00)

(30) Priority Data:

9901824.4	27 January 1999 (27.01.99)	GB
9917271.0	22 July 1999 (22.07.99)	GB

(71) Applicant *(for all designated States except US)*: GRAF INTERNATIONAL LIMITED [GB/GB]; Idenden House, Medway Street, Maidstone, Kent ME14 1JT (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: FRANCESCO, Gino [GB/GB]; Graf International Limited, Idenden House, Medway Street, Maidstone, Kent ME14 1JT (GB).

(74) Agent: BROOKES & MARTIN; High Holborn House, 52–54 High Holborn, London WC1V 6SE (GB).

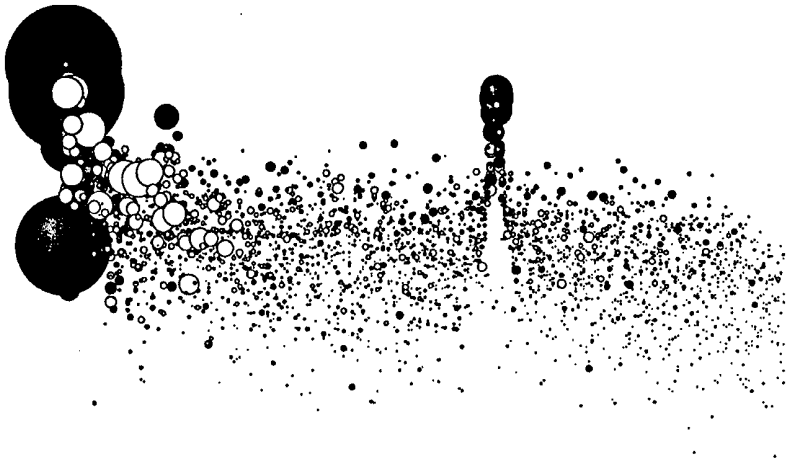
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: VISUALISATION SYSTEM



(57) Abstract

The present invention relates to a system for the visualisation of waveforms especially waveforms derived from an activity of a human or other living body. In its broadest sense, the present invention takes a waveform, however that may have been generated, and processes the waveform into a pleasing graphic form which may be printed or otherwise displayed. In particular, there is described a visualisation system comprising acquisition means for acquiring an electrical signal corresponding to a function of a subject human or other body; data processing means and graphic processing means, the data processing means processing the electrical signal into a form from which the graphic processing means can produce a graphic representation of the function of the subject. There is also described a method of generating a graphic representation of a function of a human or other body, the method comprising the steps of obtaining an electrical signal corresponding to the function; processing the signal to obtain a dataset; and processing the dataset to produce a graphic image. Preferably the function relates to a physiological process, typically a brainwave function acquired using an electroencephalograph.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

VISUALISATION SYSTEM

The present invention relates to a system for the visualisation of waveforms especially waveforms derived from an activity of the human or animal body.

In its broadest sense, the present invention takes a waveform, however that may have been generated, and processes the waveform into a pleasing graphic form which may be printed or otherwise displayed.

According to the present invention there is provided, in one aspect, a visualisation system comprising acquisition means for acquiring an electrical signal corresponding to a function of a subject human or other body; data processing means and graphic processing means, the data processing means processing the electrical signal into a form from which the graphic processing means can produce a graphic representation of the function of the subject.

In another aspect, the present invention provides a method of generating a graphic representation of a function of a human or other body, the method comprising the steps of obtaining an electrical signal corresponding to the function; processing the signal to obtain a dataset; and processing the dataset to produce a graphic image.

Preferably the function relates to a physiological process. Typically it is a brainwave function and the acquisition means comprises an electroencephalograph.

Alternatively, the function may be an audible output from the body, such as speech or singing. Typically, in this case, the acquisition means comprises a microphone coupled to a computer or other means for digitising the sound output.

Preferably, the data processing means and/or the graphic processing means includes data selection and manipulation means adapted to enable a user to select and manipulate portions of the data from which the graphic representation is produced. Preferably, the system also includes means for combining datasets corresponding to a plurality of electrical signals.

The above and other aspects of the present invention will now be described in further detail with reference, by way of example only, to the accompanying drawings in which:

Figure 1 is an electroencephalogram of a subject;

Figure 2 shows the data encompassed in the T3 channel of the encephalogram of Figure 1, extracted into a spreadsheet format;

Figure 3 is a power spectrum of the data of Figure 2;

Figure 4 is an enlarged section of the spectrum of Figure 3;

Figure 5 is an expanded version of the spectrum of Figure 3;

Figure 6 shows the spectrum of Figure 4 displayed in the format of a radar scan;

Figure 7 is a collection of superimposed radar contour charts derived in the same manner as Figures 2 to 6 from the data of Figure 1;

Figure 8 is a filled radar chart version of the chart of Figure 7;

Figure 9 is a spectrum of a sampled section of a voice sound name;

Figure 10 shows a radar contour chart derived from the spectrum of Figure 9;

Figure 11 shows a filled radar chart derived from the spectrum of Figure 9; and

Figure 12 shows a bubble chart version of the charts of Figures 7 and 8.

In a first embodiment, the system of the present invention obtains data corresponding to brain electrical activity by means of an electroencephalograph (EEG) apparatus which includes a plurality of electrodes placed upon the subject's head. EEG is typically used to monitor beta, alpha, theta and delta brainwave channels. The raw electroencephalogram data obtained is illustrated in Figure 1 and comprises a plurality of electrical signals or waveforms 10 corresponding to channels of data relating to the different types of brainwave (α, β, θ, γ) and also to data retrieved from different locations on the skull, for example, forehead, temples and so on. In the following illustrative example, a single channel, known as T3, is used to generate the data to be processed, but any one or more channels could be used at the option of the user. A channel waveform with a wide variance in peak height could be chosen as being expected to produce an interesting graphic form. The waveform of a channel which is associated with a particular brain function might be selected.

The waveform data is converted into a spreadsheet format as shown in Figure 2. This conversion can be affected by suitable software such as the commercially available LabView (TM) and MATLAB (TM) software which can be used to respectively extract and analyse the EEG data. The spreadsheet data can then be processed using other

software to generate preliminary waveforms such as that shown in Figure 3. Microsoft Excel® 97 includes suitable routines. In Figure 3, the data from twenty three separate scans of the T3 channel have been processed as waveforms and superposed. It will be observed that there is a sharp peak at the 50Hz position. This, in fact, arises through interference from the mains electricity supply and can be filtered out. As shown in Figure 4, all or only a section of the full scan can be selected for further processing. Indeed, for the present purposes the range from 8Hz to 20Hz is preferred. In Figure 5, the scale of the abscissa of the spectra of Figure 3 has been expanded and then, using a routine in Microsoft Excel, converted into a "radar" chart (Figure 6). Preferably, for visual effect, each of the twenty three scans would be represented in Figures 3 to 6 in a different colour.

Figure 7 illustrates the same data processed into a radar chart using slightly different parameters. Figure 8 shows the same chart but with shading added to each set of scan data. It is important to realise that as each scan is superposed it may overlie the colouration of the spectrum below such that, in the shaded graphic, fewer than the full twenty three spectra may be visible.

In the application of the present invention, the data used may be extracted from an EEG used for medical purposes. However, this is not essential for the purposes for which the present invention is particularly intended. As such, accuracy in data acquisition is not of paramount importance. The present inventor has also devised a headset (not illustrated) which includes means for holding the headset on a wearer's head and incorporates the necessary electrodes to enable a brainwave activity scan to be obtained. Typically, the

electrodes need only sense a single channel. The headset is connected to an electroencephalogram processing unit, typically in the form of a computer expansion card. The data is then software processed further as described above to produce the output graphic. Additional channels can be "generated" electronically based on the data derived from the channel data actually acquired.

The quantity of data required to be acquired will depend upon the level of detail required in the final image. Acquisition for ten seconds may provide sufficient data for a single channel.

To illustrate the wide application of the present invention, reference is made to Figures 9, 10 and 11. Instead of an EEG, the waveform is the power spectrum derived from sampling (at 22.05 KHz) a 3 to 5 second recording of a person's speech (Figure 9). The recording was made using a conventional computer fitted with a sound card and microphone and was saved as a 'Wave sound (.wav)' file. As before the data is processed into a Microsoft Excel® spreadsheet from which a radar contour plot (Figure 10) and radar filled plot (Figure 11) were obtained. Figure 10 and 11 show plots obtained at just one sampled frequency. Several frequencies can be sampled sequentially and the results overlayed to produce a multiple layer graphic as, for example, is shown in Figure 7 or 8.

Alternative graphic outputs are, of course, derivable from the same data. For example, the same data used to produce the radar plot of Figure 8 can produce a scatter chart of the "bubble" type as shown in Figure 12.

The graphic image (as, for example, shown in Figures 6 to 8 or 10 to 12) can be combined with other images before being output. For example, the image could be a photographic image of the person who provided the original data or simply an additional background graphic.

The graphic image can then be output in the form desired by the user. For example, it could be printed out simply to provide a picture for mounting or for forming greetings cards or badges etc. Alternatively, the graphic can be reverse printed using transfer inks to enable the graphic to be subsequently applied to clothing such as T-shirts.

The image can, of course, be saved in a digital format for further manipulation and subsequent use by the user. Particularly as regards the multiple layer or three-dimensional graphics, these can be further processed into holographic images. Additionally, a plurality of images, perhaps collected over an extended period of time, can be adapted into the form of a personalised cartoon or screen saver for a computer. The data could be adapted such as by rotation, translation and/or changing of colours, such that a moving and changing graph can be displayed on a computer screen, Additional features, such as zooming in and zooming out could be added. All of these forms of data manipulation are well known for computer animation and screen savers and would be readily apparent to a person skilled in the art. It will be apparent that any portion of the data (for example, the frequency portion) from any EEG scan or sound extract could be used to produce a screen saver or other program, as can any of the EEG channels. It is also envisaged that the program could be formed from scans of a plurality of individuals, such as of all the people who would use a particular computer. The data

may be combined in such a way as to provide an animated interaction between each data set.

For the finished screen saver or other program, the user will be able to see on the screen of their personal computer their personal brainwave which will be automatically manipulated to cause visually appealing effects. This data has never been used for such a purpose before and the user will have a sense not only of this unique data which they may not have appreciated before but will also provide an important psychological link with the computer itself.

The skilled reader will readily appreciate methods for improving the capture of data on the EEG, such as coupling the electrodes to the right parts of a person's head, providing or, selectively, withdrawing particular stimuli from the person during capture of brainwaves (for example ensuring the person closes his/her eyes during data capture, and so on).

It is not necessary for the brainwave or audible data to be human data, it could, for example, relate to a bird or animal of particular interest to the user, for example a pet.

Given the above discussion of the various aspects of the present invention, those skilled in the art will be readily able to devise and construct apparatus suitable for acquiring and processing the relevant data without further instruction.

CLAIMS

1. A visualisation system for visualising a function of the body of a living being; the system comprising acquisition means for acquiring an electrical signal corresponding to a function of a subject body; data processing means and graphic processing means, the data processing means processing the electrical signal into a form from which the graphic processing means can produce a graphic representation of the function of the subject.

2. A visualisation system as claimed in Claim 1 wherein the function relates to a physiological process.

3. A visualisation system as claimed in Claim 2 wherein the physiological process is a brainwave function and the acquisition means comprises an electroencephalograph.

4. A visualisation system as claimed in Claim 1 wherein the function is an audible output from the body.

5. A visualisation system as claimed in Claim 4 wherein the acquisition means comprises a microphone coupled to a computer or other means for digitising the sound output.

6. A visualisation system as claimed in any one of claims 1 to 5 wherein the data processing means and/or the graphic processing means includes data selection and manipulation means adapted to enable a user to select and manipulate portions of the data from which the graphic representation is produced.

7. A visualisation system as claimed in Claim 6 wherein the system also includes means for combining datasets corresponding to a plurality of electrical signals.

8. A method of generating a graphic representation of a function of a body of a living being, the method comprising the steps of obtaining an electrical signal corresponding to the function; processing the signal to obtain a dataset; and processing the dataset to produce a graphic image.

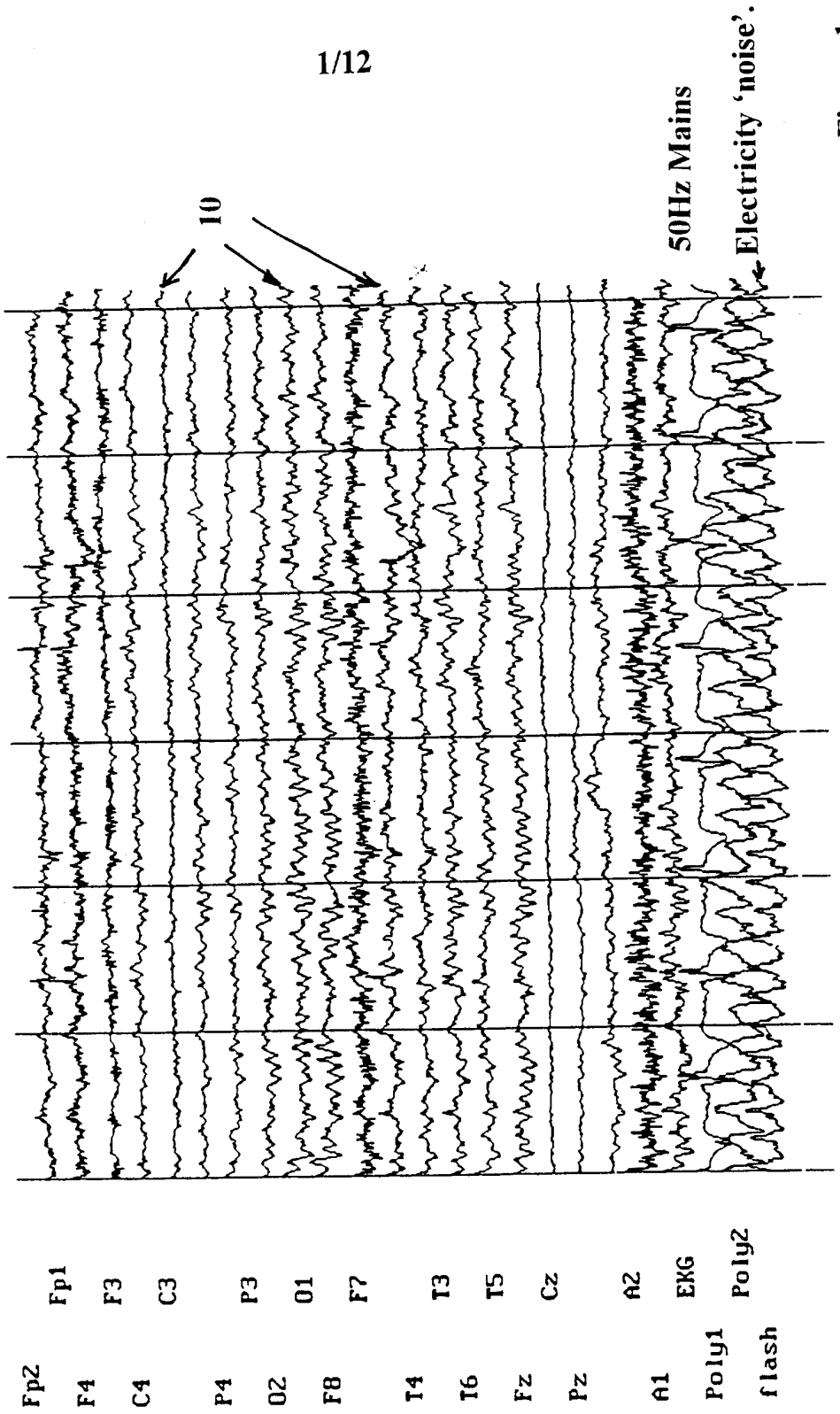
9. A method as claimed in Claim 8 wherein the function relates to a physiological process.

10. A method as claimed in Claim 9 wherein the physiological process is a brainwave function and is obtained by means of an electroencephalograph.

11. A method as claimed in Claim 8 wherein the function is an audible output from the body.

12. A method as claimed in any one of claims 8 to 11 wherein portions of the data may be selected and manipulated prior to production of the graphic representation.

13. A method as claimed in Claim 12 wherein datasets corresponding to a plurality of electrical signals are combined.



RAW DATA EEG SCAN

Figure 1

5.61E+00	8.39E+00	5.61E+00	8.40E+00	5.61E+00	8.29E+00	5.61E+00	8.47E+00	5.61E+00	8.46E+00	5.61E+00	8.52E+00	5.61E+00
5.78E+00	8.40E+00	5.78E+00	8.36E+00	5.78E+00	8.25E+00	5.78E+00	8.32E+00	5.78E+00	8.39E+00	5.78E+00	8.57E+00	5.78E+00
5.94E+00	8.38E+00	5.94E+00	8.40E+00	5.94E+00	8.35E+00	5.94E+00	8.38E+00	5.94E+00	8.40E+00	5.94E+00	8.54E+00	5.94E+00
6.10E+00	8.36E+00	6.10E+00	8.43E+00	6.10E+00	8.32E+00	6.10E+00	8.33E+00	6.10E+00	8.44E+00	6.10E+00	8.57E+00	6.10E+00
6.27E+00	8.32E+00	6.27E+00	8.40E+00	6.27E+00	8.30E+00	6.27E+00	8.33E+00	6.27E+00	8.34E+00	6.27E+00	8.58E+00	6.27E+00
6.43E+00	8.36E+00	6.43E+00	8.42E+00	6.43E+00	8.28E+00	6.43E+00	8.35E+00	6.43E+00	8.42E+00	6.43E+00	8.57E+00	6.43E+00
6.59E+00	8.33E+00	6.59E+00	8.35E+00	6.59E+00	8.31E+00	6.59E+00	8.39E+00	6.59E+00	8.35E+00	6.59E+00	8.47E+00	6.59E+00
6.75E+00	8.32E+00	6.75E+00	8.37E+00	6.75E+00	8.29E+00	6.75E+00	8.33E+00	6.75E+00	8.41E+00	6.75E+00	8.54E+00	6.75E+00
6.92E+00	8.29E+00	6.92E+00	8.39E+00	6.92E+00	8.30E+00	6.92E+00	8.34E+00	6.92E+00	8.37E+00	6.92E+00	8.46E+00	6.92E+00
7.08E+00	8.32E+00	7.08E+00	8.38E+00	7.08E+00	8.27E+00	7.08E+00	8.36E+00	7.08E+00	8.40E+00	7.08E+00	8.52E+00	7.08E+00
7.24E+00	8.27E+00	7.24E+00	8.33E+00	7.24E+00	8.24E+00	7.24E+00	8.35E+00	7.24E+00	8.35E+00	7.24E+00	8.47E+00	7.24E+00
7.41E+00	8.25E+00	7.41E+00	8.31E+00	7.41E+00	8.20E+00	7.41E+00	8.28E+00	7.41E+00	8.30E+00	7.41E+00	8.40E+00	7.41E+00
7.57E+00	8.21E+00	7.57E+00	8.37E+00	7.57E+00	8.22E+00	7.57E+00	8.30E+00	7.57E+00	8.45E+00	7.57E+00	8.42E+00	7.57E+00
7.73E+00	8.18E+00	7.73E+00	8.27E+00	7.73E+00	8.24E+00	7.73E+00	8.27E+00	7.73E+00	8.39E+00	7.73E+00	8.40E+00	7.73E+00
7.89E+00	8.29E+00	7.89E+00	8.27E+00	7.89E+00	8.26E+00	7.89E+00	8.27E+00	7.89E+00	8.38E+00	7.89E+00	8.39E+00	7.89E+00
8.06E+00	8.24E+00	8.06E+00	8.29E+00	8.06E+00	8.24E+00	8.06E+00	8.23E+00	8.06E+00	8.38E+00	8.06E+00	8.38E+00	8.06E+00
8.22E+00	8.20E+00	8.22E+00	8.28E+00	8.22E+00	8.28E+00	8.22E+00	8.34E+00	8.22E+00	8.43E+00	8.22E+00	8.43E+00	8.22E+00
8.38E+00	8.22E+00	8.38E+00	8.30E+00	8.38E+00	8.21E+00	8.38E+00	8.37E+00	8.38E+00	8.42E+00	8.38E+00	8.37E+00	8.38E+00
8.54E+00	8.20E+00	8.54E+00	8.34E+00	8.54E+00	8.23E+00	8.54E+00	8.26E+00	8.54E+00	8.38E+00	8.54E+00	8.38E+00	8.54E+00
8.71E+00	8.23E+00	8.71E+00	8.37E+00	8.71E+00	8.23E+00	8.71E+00	8.30E+00	8.71E+00	8.46E+00	8.71E+00	8.33E+00	8.71E+00
8.87E+00	8.22E+00	8.87E+00	8.35E+00	8.87E+00	8.29E+00	8.87E+00	8.25E+00	8.87E+00	8.40E+00	8.87E+00	8.45E+00	8.87E+00
9.03E+00	8.20E+00	9.03E+00	8.34E+00	9.03E+00	8.22E+00	9.03E+00	8.35E+00	9.03E+00	8.38E+00	9.03E+00	8.38E+00	9.03E+00
9.20E+00	8.27E+00	9.20E+00	8.42E+00	9.20E+00	8.27E+00	9.20E+00	8.31E+00	9.20E+00	8.41E+00	9.20E+00	8.40E+00	9.20E+00
9.36E+00	8.22E+00	9.36E+00	8.38E+00	9.36E+00	8.27E+00	9.36E+00	8.32E+00	9.36E+00	8.34E+00	9.36E+00	8.39E+00	9.36E+00
9.52E+00	8.23E+00	9.52E+00	8.47E+00	9.52E+00	8.21E+00	9.52E+00	8.36E+00	9.52E+00	8.45E+00	9.52E+00	8.37E+00	9.52E+00
9.68E+00	8.33E+00	9.68E+00	8.47E+00	9.68E+00	8.25E+00	9.68E+00	8.31E+00	9.68E+00	8.49E+00	9.68E+00	8.52E+00	9.68E+00
9.85E+00	8.30E+00	9.85E+00	8.47E+00	9.85E+00	8.31E+00	9.85E+00	8.31E+00	9.85E+00	8.51E+00	9.85E+00	8.47E+00	9.85E+00
1.00E+01	8.34E+00	1.00E+01	8.47E+00	1.00E+01	8.25E+00	1.00E+01	8.43E+00	1.00E+01	8.50E+00	1.00E+01	8.53E+00	1.00E+01
1.02E+01	8.29E+00	1.02E+01	8.50E+00	1.02E+01	8.29E+00	1.02E+01	8.39E+00	1.02E+01	8.50E+00	1.02E+01	8.52E+00	1.02E+01
1.03E+01	8.41E+00	1.03E+01	8.52E+00	1.03E+01	8.30E+00	1.03E+01	8.38E+00	1.03E+01	8.43E+00	1.03E+01	8.57E+00	1.03E+01
1.05E+01	8.45E+00	1.05E+01	8.54E+00	1.05E+01	8.31E+00	1.05E+01	8.41E+00	1.05E+01	8.44E+00	1.05E+01	8.47E+00	1.05E+01
1.07E+01	8.46E+00	1.07E+01	8.49E+00	1.07E+01	8.35E+00	1.07E+01	8.40E+00	1.07E+01	8.45E+00	1.07E+01	8.52E+00	1.07E+01
1.08E+01	8.40E+00	1.08E+01	8.50E+00	1.08E+01	8.37E+00	1.08E+01	8.41E+00	1.08E+01	8.41E+00	1.08E+01	8.55E+00	1.08E+01
1.10E+01	8.45E+00	1.10E+01	8.50E+00	1.10E+01	8.32E+00	1.10E+01	8.39E+00	1.10E+01	8.39E+00	1.10E+01	8.48E+00	1.10E+01
1.11E+01	8.43E+00	1.11E+01	8.45E+00	1.11E+01	8.35E+00	1.11E+01	8.38E+00	1.11E+01	8.43E+00	1.11E+01	8.40E+00	1.11E+01

Figure 2

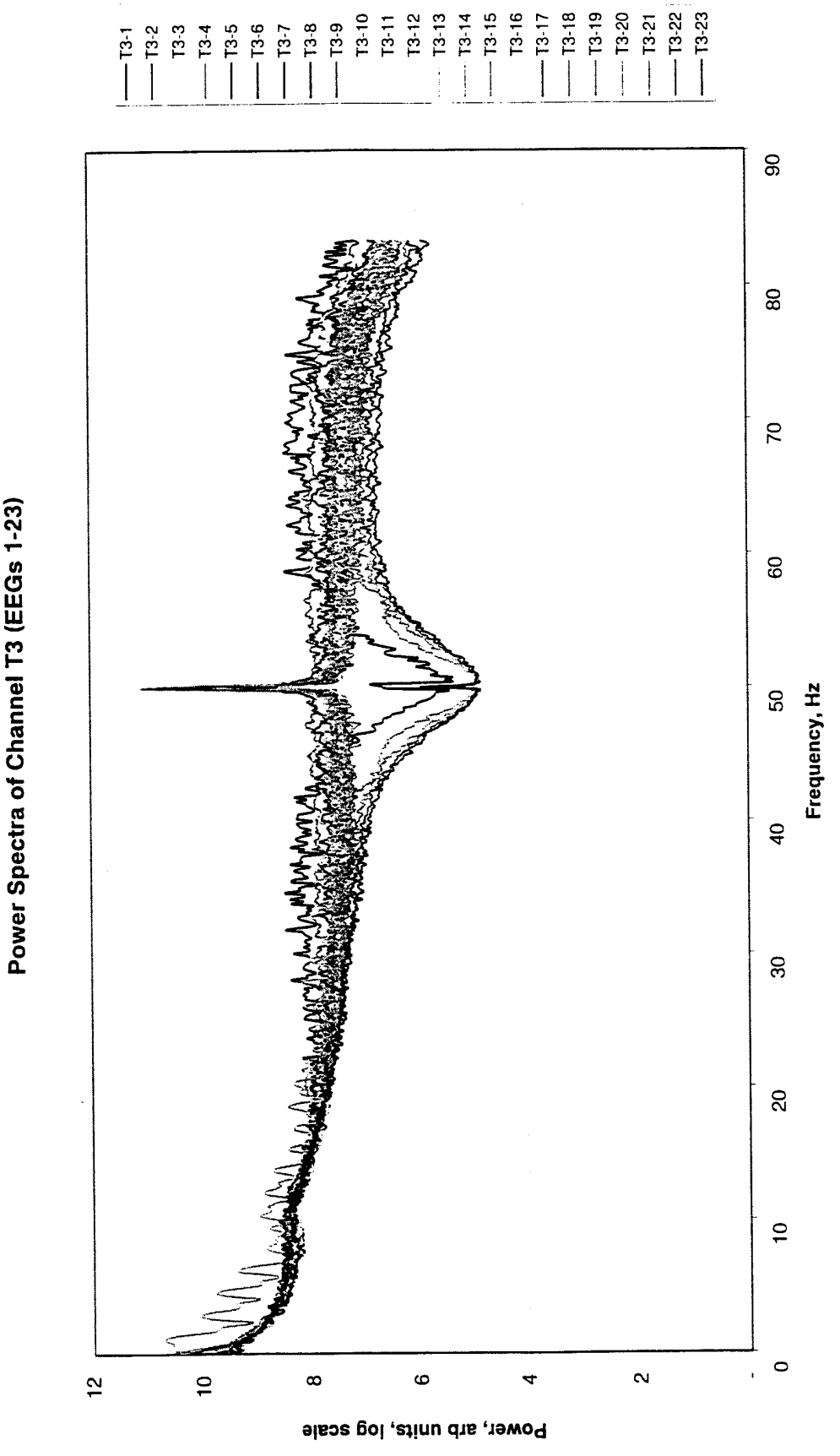

Power Spectra of Channel T3 (EEGs 1-23)
T3-1
T3-2
T3-3
T3-4
T3-5
T3-6
T3-7
T3-8
T3-9
T3-10
T3-11
T3-12
T3-13
T3-14
T3-15
T3-16
T3-17
T3-18
T3-19
T3-20
T3-21
T3-22
T3-23
Power, arb units, log scale
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
Frequency, Hz

Figure 3

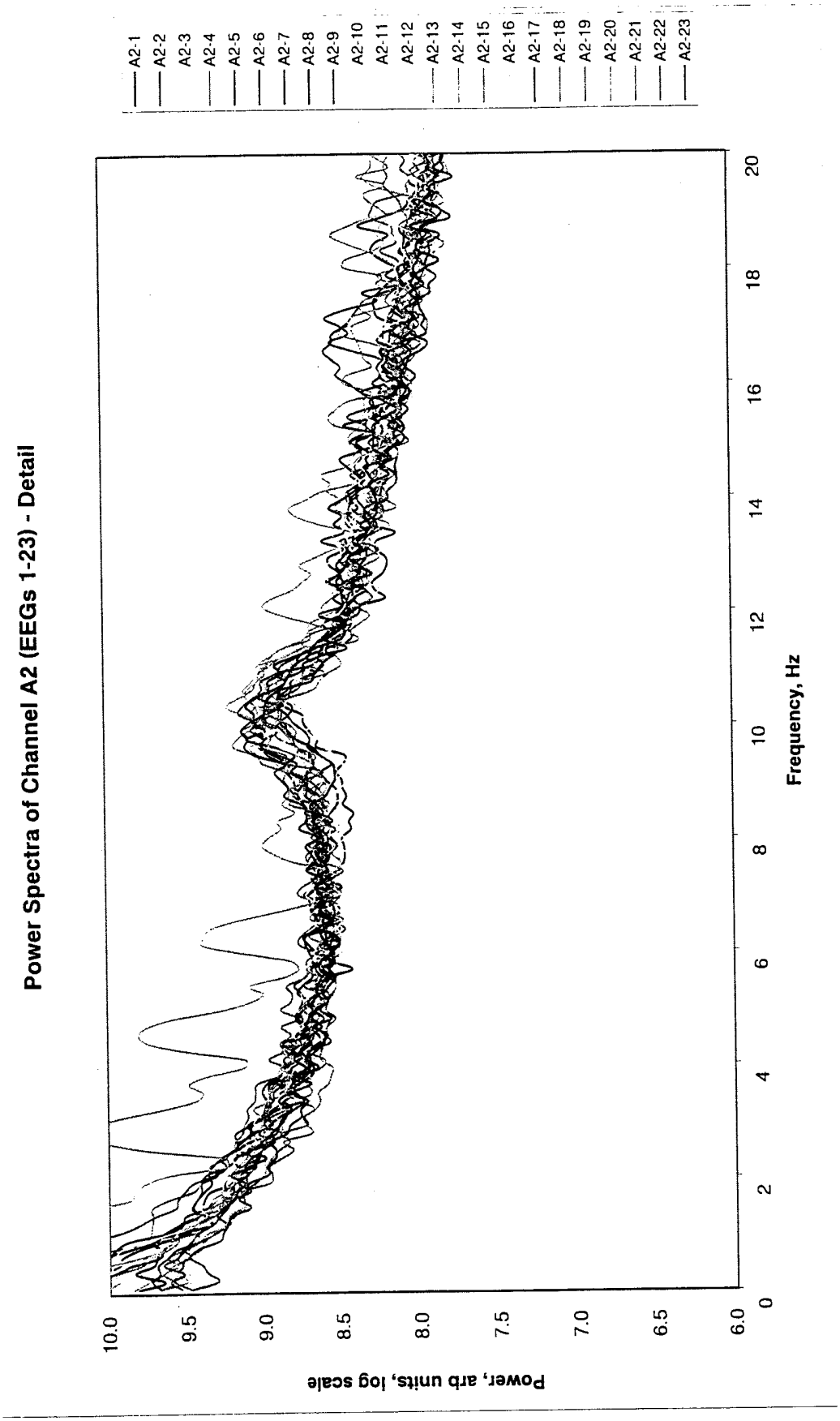

Power Spectra of Channel A2 (EEGs 1-23) - Detail
A2-1
A2-2
A2-3
A2-4
A2-5
A2-6
A2-7
A2-8
A2-9
A2-10
A2-11
A2-12
A2-13
A2-14
A2-15
A2-16
A2-17
A2-18
A2-19
A2-20
A2-21
A2-22
A2-23
Power, arb units, log scale
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
2
4
6
8
10
12
14
16
18
20
Frequency, Hz

Figure 4

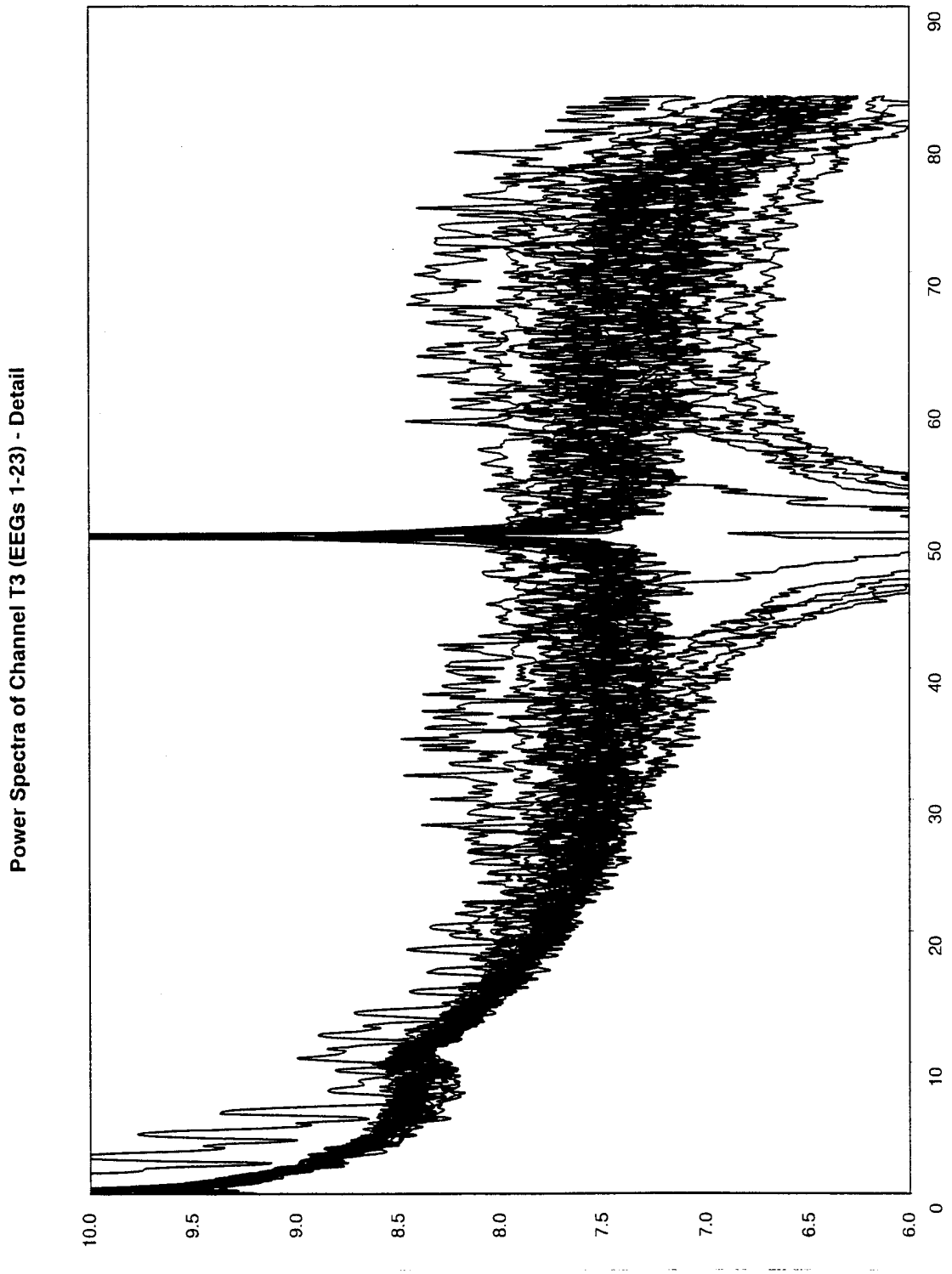

Power Spectra of Channel T3 (EEGs 1-23) - Detail
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
10
20
30
40
50
60
70
80
90

Figure 5

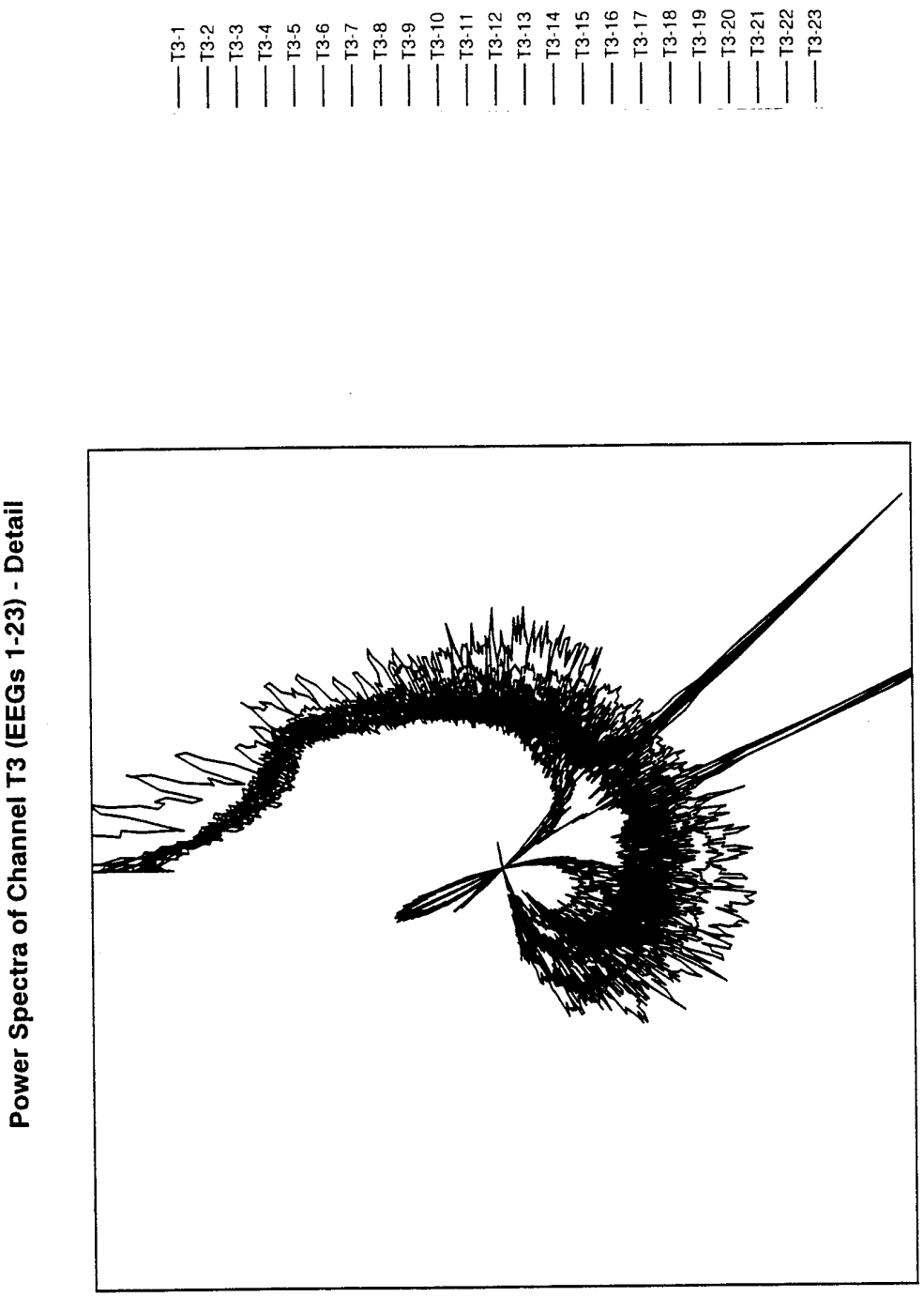

T3-1
T3-2
T3-3
T3-4
T3-5
T3-6
T3-7
T3-8
T3-9
T3-10
T3-11
T3-12
T3-13
T3-14
T3-15
T3-16
T3-17
T3-18
T3-19
T3-20
T3-21
T3-22
T3-23
Power Spectra of Channel T3 (EEGs 1-23) - Detail

Figure 6

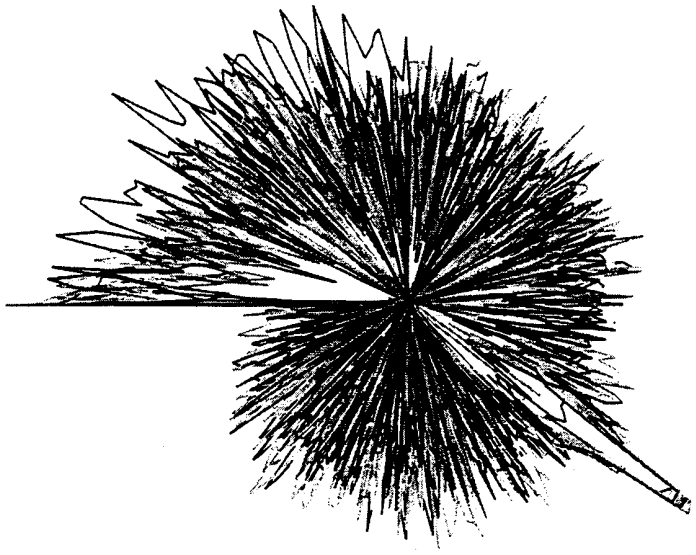


Figure 7

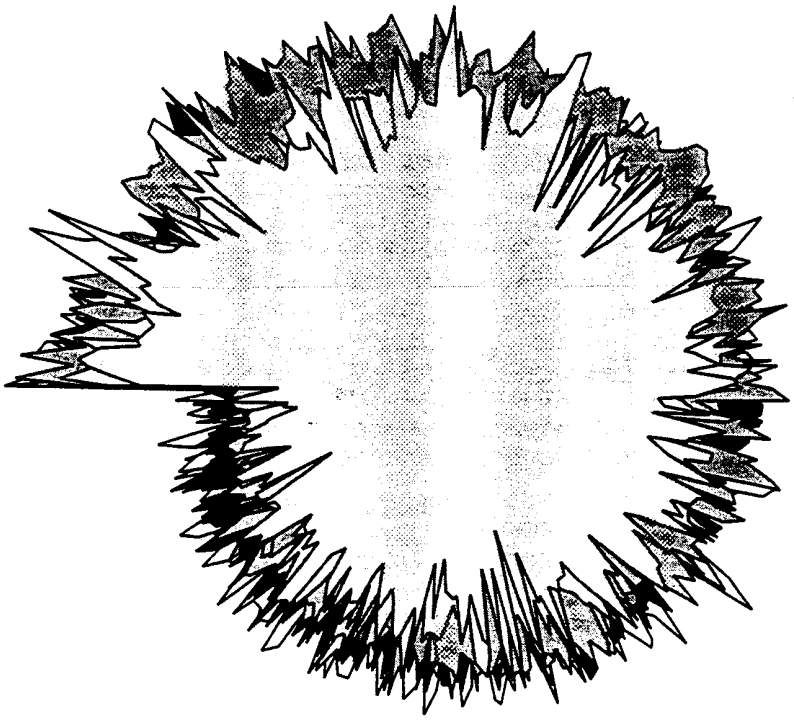


Figure 8

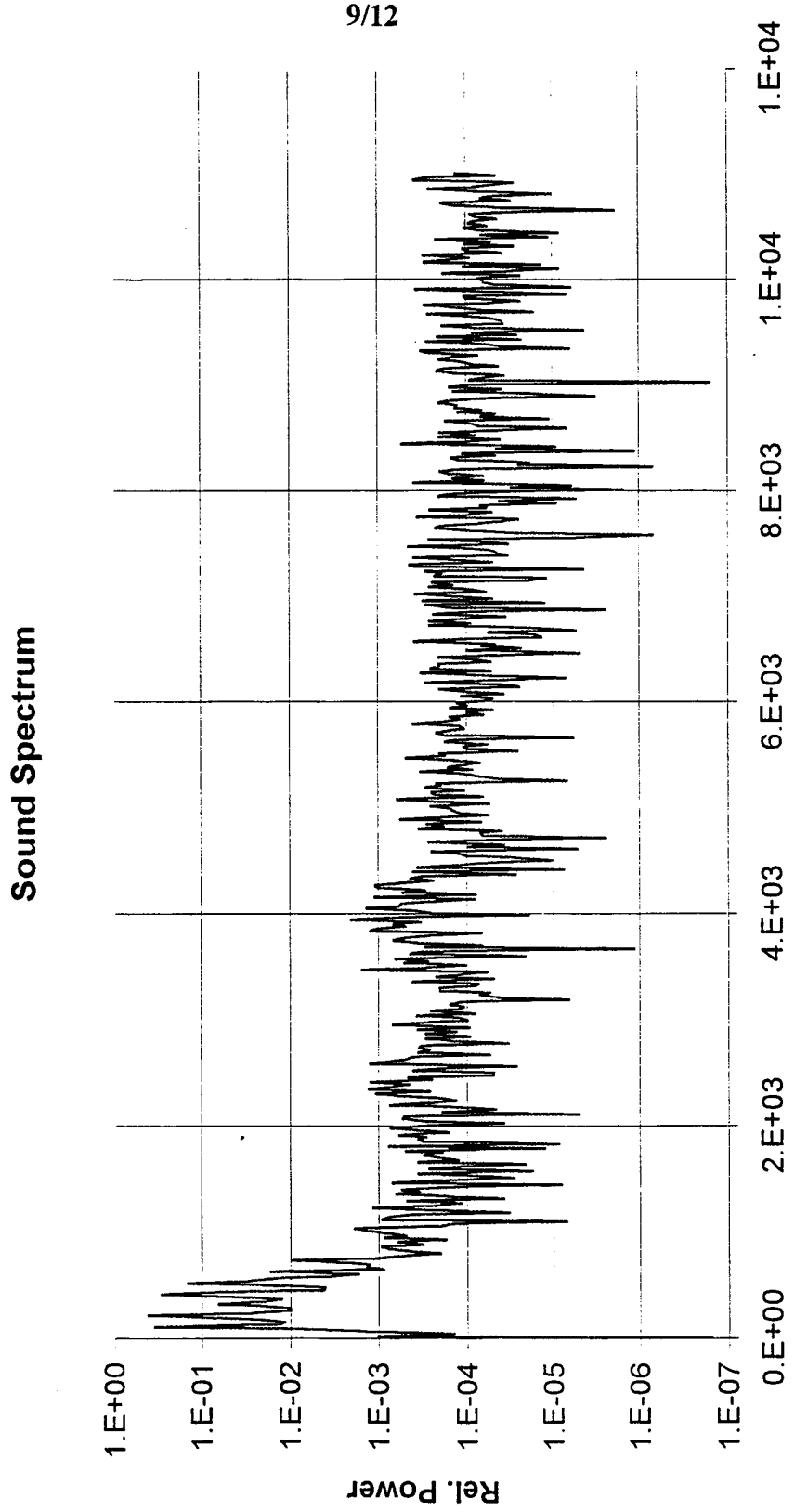

Sound Spectrum
Rel. Power
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
0.E+00
2.E+03
4.E+03
6.E+03
8.E+03
1.E+04
1.E+04
Frequency, Hz

Figure 9

Sound Spectrum - Radar Contour

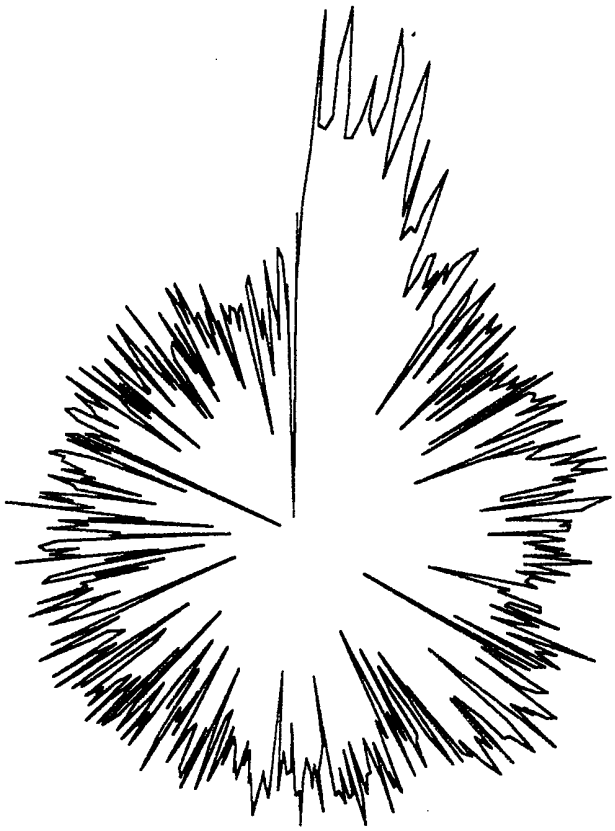


Figure 10

Sound Spectrum - Radar Filled

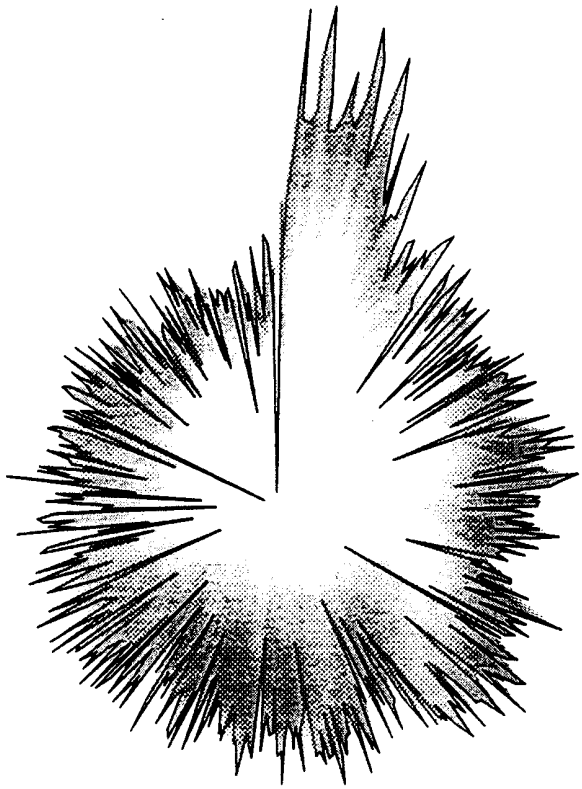


Figure 11

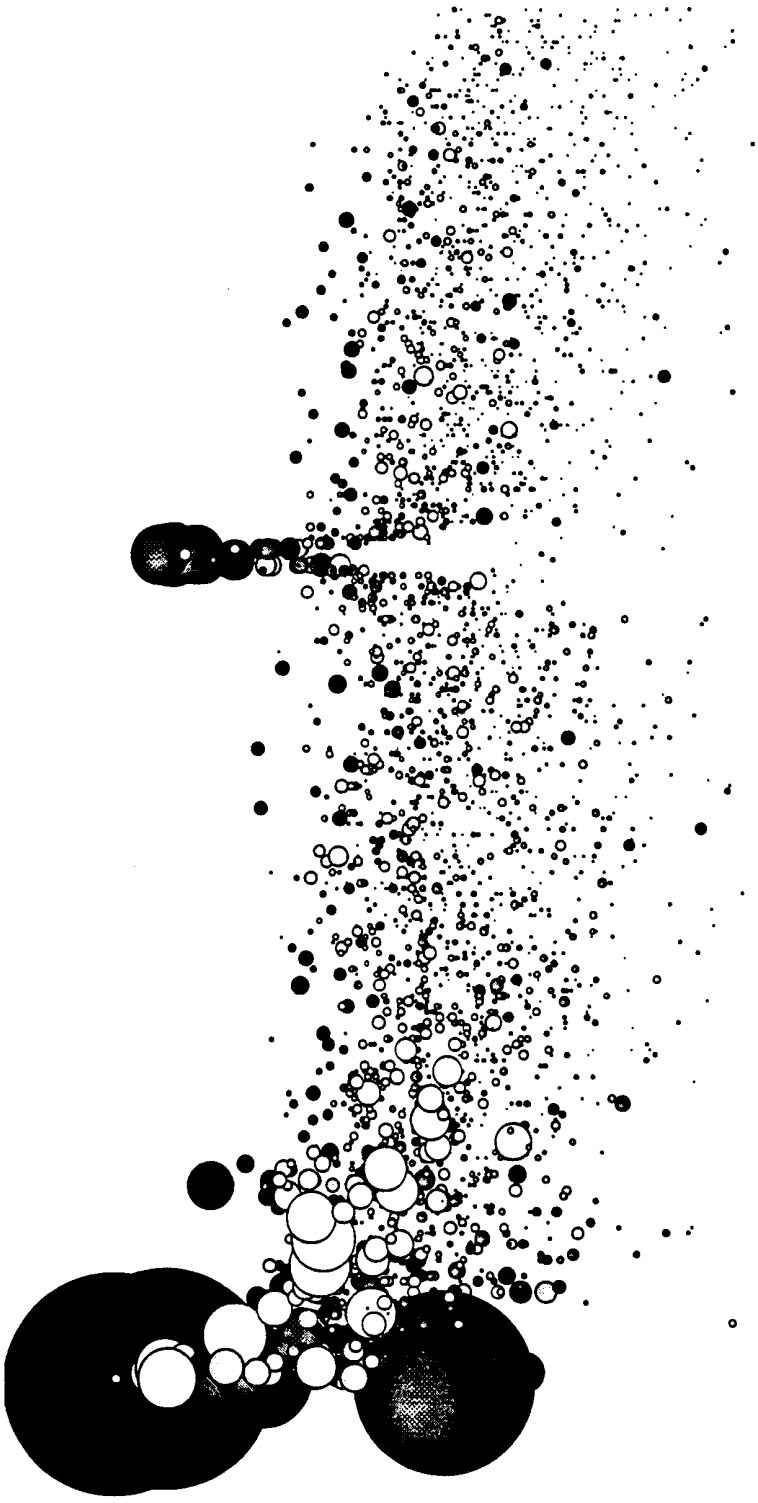


Figure 12

INTERNATIONAL SEARCH REPORT

Int. ational Application No
PCT/GB 00/00204

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B5/0476

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 755 230 A (BUCKETT JAMES R ET AL) 26 May 1998 (1998-05-26) column 2, line 66 -column 3, line 31 ---	1-3,8-10
X	WO 91 09565 A (SWINBURNE LTD) 11 July 1991 (1991-07-11) page 25, line 3 - line 8 page 27, line 19 - line 23 figure 2 ---	1-3, 6-10,12, 13
X	US 5 832 441 A (BRUNET PETER THOMAS ET AL) 3 November 1998 (1998-11-03) column 2, line 57 -column 3, line 10 column 4, line 28 - line 65 column 8, line 40 - line 62 column 10, line 14 -column 11, line 5 --- -/--	1,2,4-9, 11-13

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 May 2000	24/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Martelli, L

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte. .ional Application No
PCT/GB 00/00204

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 888 806 A (CHAN SHUFAN ET AL) 19 December 1989 (1989-12-19) column 10, line 59 -column 11, line 2 column 12, line 39 - line 41 column 15, line 20 - line 29 column 16, line 36 - line 50	1,2,4-6, 8,9,11, 12

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. ..ional Application No
PCT/GB 00/00204

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5755230 A	26-05-1998	AU 7369196 A	09-04-1997
		CN 1199329 A	18-11-1998
		EP 0852476 A	15-07-1998
		JP 11511367 T	05-10-1999
		WO 9710747 A	27-03-1997
WO 9109565 A	11-07-1991	US 5331969 A	26-07-1994
		AU 7036691 A	24-07-1991
US 5832441 A	03-11-1998	NONE	
US 4888806 A	19-12-1989	NONE	