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(54) **METHOD FOR EXAMINING OBJECTS USING ULTRASOUND**

(75) Inventor: **Franz Wiesauer**, Zipf (AT)

Correspondence Address:
Kurt Kelman
COLLARD & ROE, P.C.
1077 Northern Boulevard
Roslyn, NY 11576 (US)

(73) Assignee: **KRETZTECHNIK AG**

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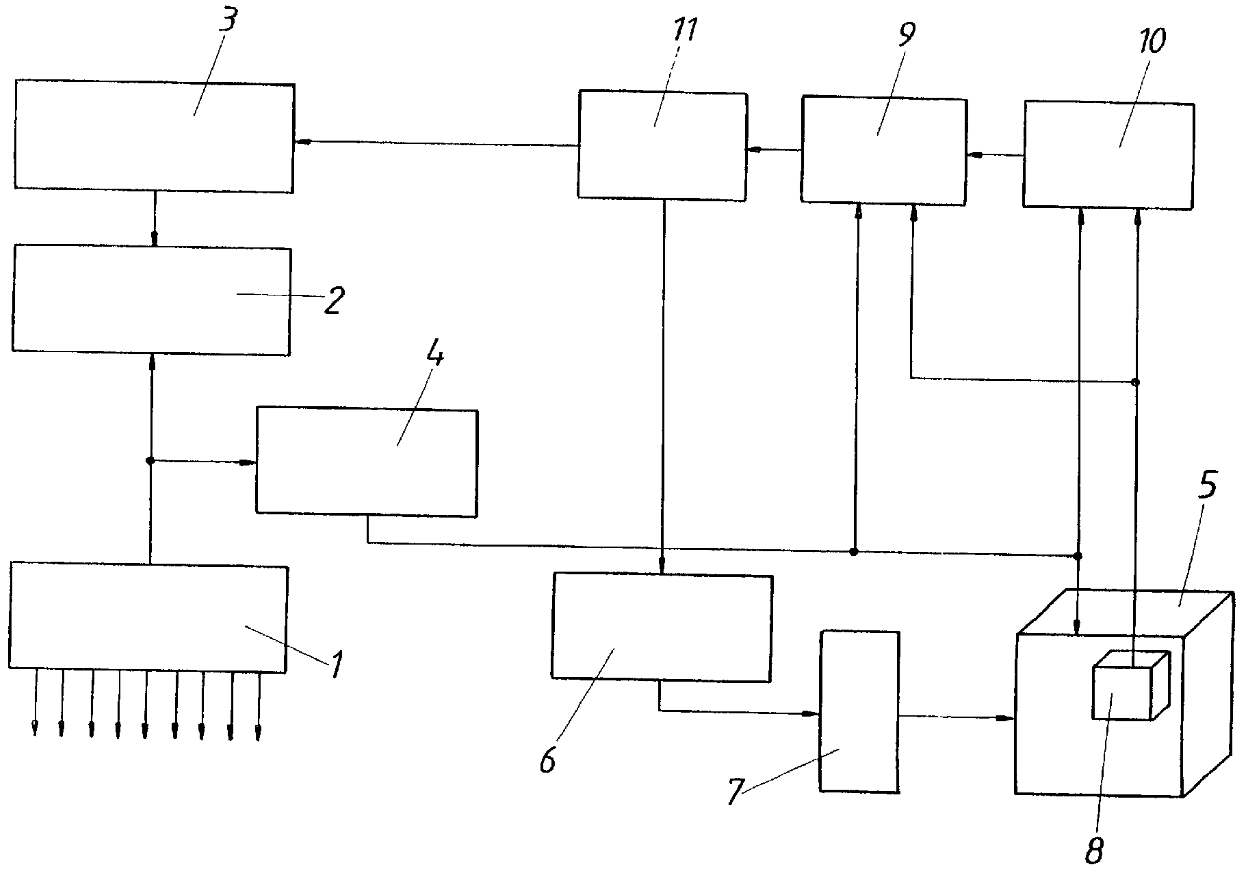
(57) **ABSTRACT**

In a method for examining objects using ultrasound according to the reflection process, in particular 3D scanning, the object is scanned with a sound head unit **(1)** with associated send/receive unit **(2, 4)** appropriate for volume scanning and the obtained echo data are stored in a volume memory **(5)** in clear assignation to the local coordinates of the reflection points. During scanning the spatial line density and/or the temporal repetition frequency, in which certain volume areas are scanned, is deflected by the contents of the information obtained or obtainable from these areas in such a form that areas having less information content are scanned more seldom and/or with less scanning density than areas having a higher information content.



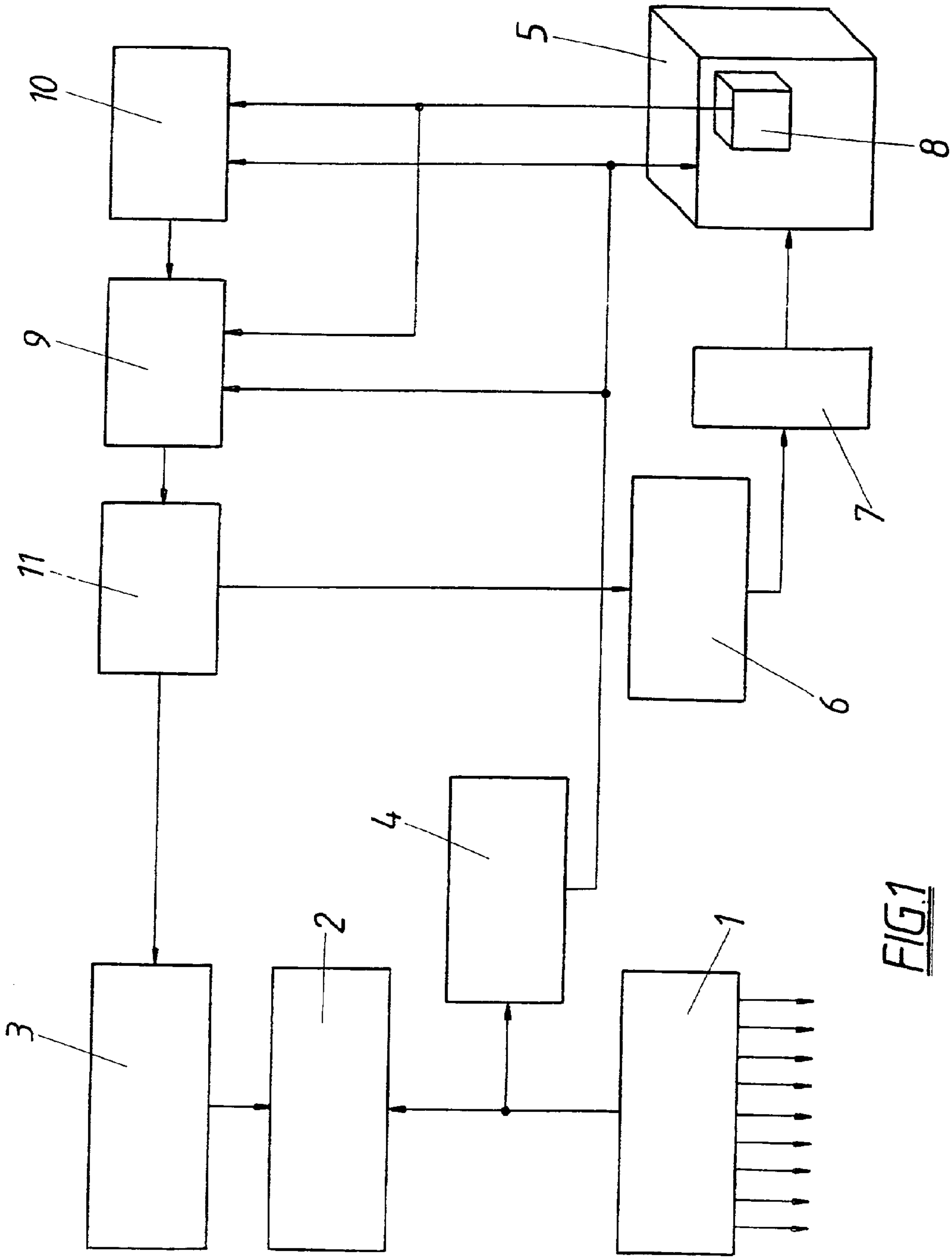


FIG. 1

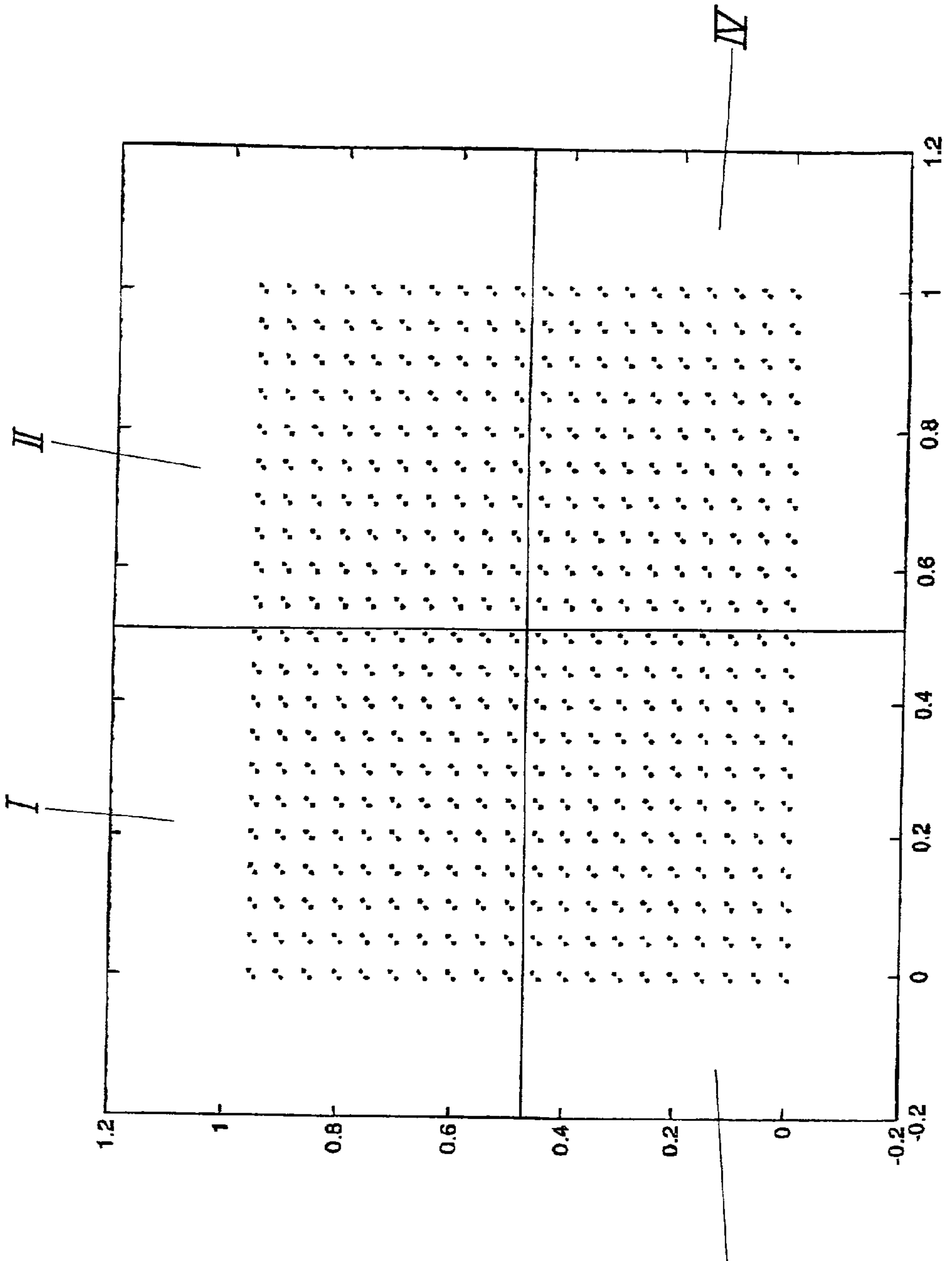


FIG.2

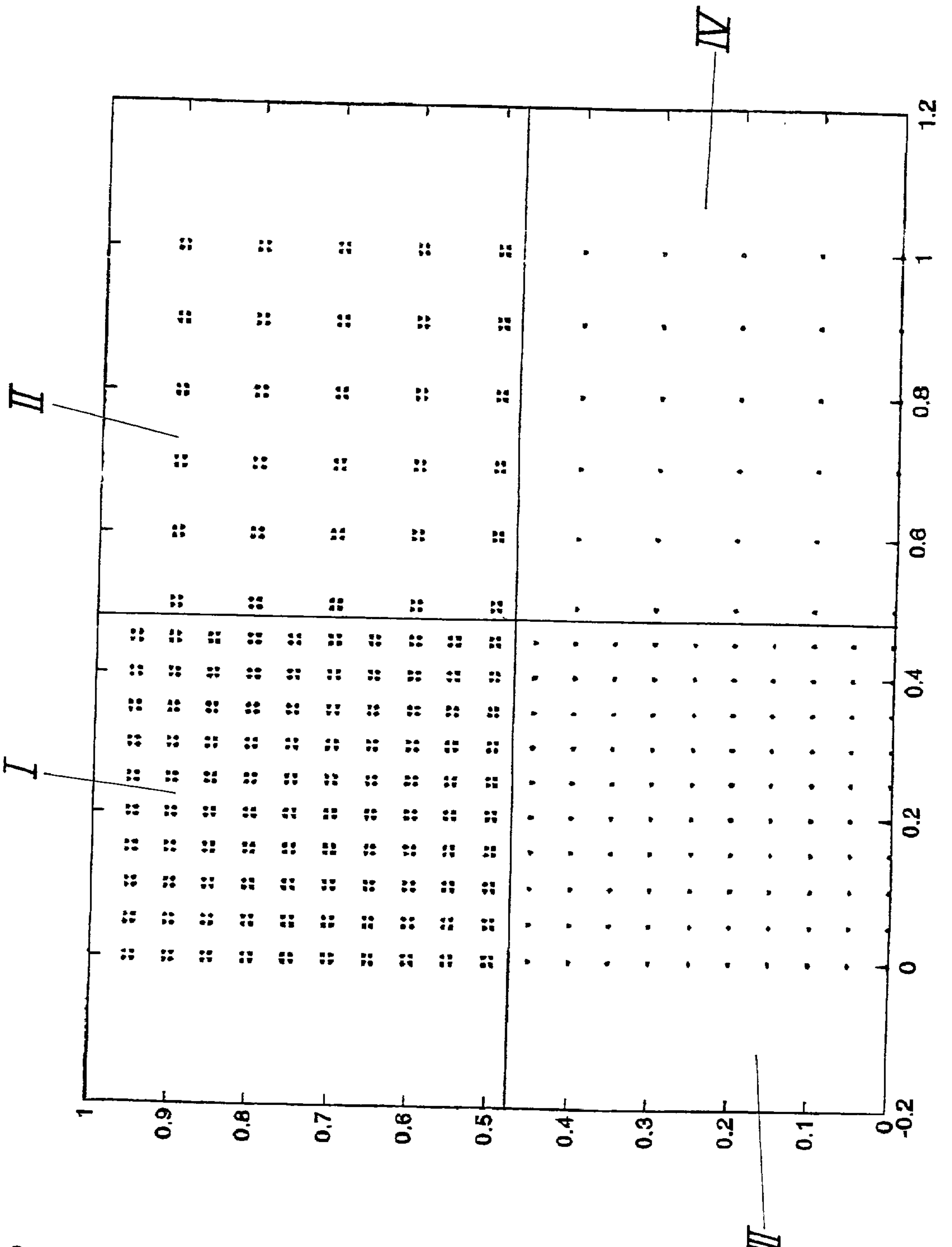


FIG.3

METHOD FOR EXAMINING OBJECTS USING ULTRASOUND

FIELD OF THE INVENTION

[0001] The present invention relates to a method for examining objects using ultrasound according to reflection processes, in particular 3D scanning, wherein the respective object is scanned with a sound head unit with associated send/receive unit appropriate for volume scanning and the obtained echoes are stored in a volume memory in clear assignation to the local coordinates of the reflection points, from which memory they are accessed according to selectable accessing criteria and can be forwarded to an evaluation unit, in particular a display unit.

DESCRIPTION OF THE PRIOR ART

[0002] Such methods have been known for quite some time and are documented in AT 358 155 B, for example, which relates to expanding the ultrasound split image recording (B image), wherein a sound beam is oscillated in a plane, thus recording a split image. To obtain the information along an idealised beam a bundled sound wave is emitted which is partially reflected by the object structures as it penetrates into the object being examined, giving rise to echoes which are evaluated according to the run time—this determines the coordinate—and according to the amplitude which determines the brightness with the B image method. With the likewise known double method changes in frequency are recorded and thus the direction of flow or floe rate in blood vessels is ascertained. The total of all assessed information as well as position information during oscillating scanning create the ultrasound image. The scanning frequency, by which a specific part of the object is rescanned, results from the maximum desired penetration depth and the number of scan lines per image. At a required penetration depth of 20 cm a period of ca. 260 microseconds elapses, until echoes are received from the maximum penetration depth on the sound head. If an ultrasound image comprises 200 scanning beams, then a specific area can be scanned about 20 times per second. With 3D scanning a split image scanning unit is moved by being oscillated or by cross adjustment, such that if for instance 200 images corresponding substantially to the B image in different positions are to be obtained from the volume each part of the volume is rescanned in only 10 seconds with the above example, leading to prolonged scanning times for unambiguous recording of a volume and in the case of animated objects changes of position in a given volume area can be viewed only disjointedly.

[0003] For increasing the scanning density it is known to generate several scan lines from each emitted ultrasound wave when the echoes are being received, whereby usually four scan lines can be guided in parallel, though for cardiological applications more than four lines can be guided and processed. These techniques can be transferred to three-dimensional scanning, but not with total success, as evident from the abovementioned example.

[0004] With instances of scanning which combine different modalities, such as a B image of the tissue and far double imaging of blood flow, the scanning pattern, rigid in terms of time and location with B images, is modified. The B image method involves scanning with a series of beams and then again with a series of beams in the double method at another site. This method makes no consideration of movement of the object and follows a temporal and local sequence.

SUMMARY OF THE INVENTION

[0005] The aim of the present invention accordingly is to create a novel method which results in improved utilisation of time used or to be used in ultrasound scanning, in particular with 3D scanning, without important information being lost.

[0006] The problem posed is solved by the method mentioned at the outset by the fact that during scanning the spatial line density and/or the temporal repetition frequency, in which certain volume areas are scanned, is deflected by the contents of the information obtained or obtainable from these areas in such a form that areas having less information content are scanned more seldom and/or with less scanning density than areas having a higher information content, for which purpose a computer is provided which ascertains details on the information content of these data records from data records received from the same local regions at different times, and/or controls a control unit used for adjusting the repetition frequency and/or the local scanning density, whereby the control unit determines the release sites of the individual scanning instances and their time.

[0007] Further advantageous embodiments are specified in the special description.

[0008] The fundamental idea of the invention is to detect those areas within a volume to be examined, which have the least temporal and/or local changes and/or also the least information content and to restrict the number of scans and their density to the required values. For example, in the case of pregnancy examinations the amniotic fluid area can be scanned with less line density and less frequently, whereby on the other hand areas with higher density of detail, such as soft tissue and areas with rapid image content change such as movement of organs, are scanned more often and more densely. The basic rule here will be the image change which actually occurs between two scanning sessions.

BRIEF DESCRIPTION OF THE DRAWING

[0009] The embodiment is illustrated by way of example in the diagram, in which:

[0010] **FIG. 1** is a station connection diagram of the overall arrangement used for the method according to the present invention, omitting a view of the image evaluation unit as well as the display unit, since in the case of the method according to the present invention it depends essentially on controlling the scanning times and the scanning density and the units required therefor,

[0011] **FIG. 2** is a diagrammatic representation of the scanning density in a volume according to the previously known methods by way of explanation of the prior art, and

[0012] **FIG. 3** shows the possible distribution of the scanning density according to the method according to the present invention in the same illustrative manner as **FIG. 2**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] **FIG. 1** shows a sound head **1** appropriate for 3D ultrasound scanning, which is activated by an ultrasound sender **2** according to control by a trigger unit **3**, whereby the received echoes are converted into electrical signals and fed to an ultrasound receiver **4**. The arrangement is known in this respect. The amplitude can be processed according to B image method and the frequency or phase change (double evaluation) of the echo signals can also be processed, whereby in the latter case evaluations can be made in the vicinity of the nominal frequency and also of the harmonic frequencies. Techniques such as parallel processing of several receiving channels in ultrasound sending and processing are feasible also. The received signals are saved in a three-dimensional memory **5**, whereby saving the information is controlled by a position controller **6** which gives information on the momentary sending location of the sound beams and to an addressing unit **7**. Within the total storage volume a volume **8** is represented as volume of interest, which means that this storage volume is of particular interest for momentary examination. In the embodiment the signals originating from the most recent scan are stored in this storage area **8** according to address. Assigned to the memory is a motion detector **9** and a detector **10** is provided for scanning image definition. The data contained in storage volume **8** are read before input of the latest data string and compared in **9**, **10** to the newly arriving data. This comparison can affect different parameters. On the one hand a comparison is preferably made as to how closely the new data match the previously stored data and movement therefrom is detected in **9**, and on the other hand a comparison is made in **10** also of how fine the texture of the new ultrasound image is. From these data computer and control unit **11**, which could also de described as the scan controller, calculates the new scan strategy.

[0014] Four identical fields are illustrated in **FIGS. 2 and 3** for better understanding, whereby Field **1** shows an area where an animated organ, which requires a high resolution for proper viewing, is present in the volume. An animated organ requiring a lower resolution is acquired in Field II, while Field III shows a still organ requiring a lower resolution than an animated organ, yet a higher resolution than a still organ (such as amniotic fluid) as found in scanning area **4**.

[0015] According to the prior art as in **FIG. 2** it is seen that the marks of the ultrasound scan lines shown as dots are distributed over the entire volume. Dots at each individual location indicate the frequency of scanning, that is, the repetition frequency. The repetition frequency is constant for each individual dot in the execution as per the prior art. By comparison, with the method according to the present invention as per **FIG. 3** area I is processed with the highest scan frequency and the highest scan density, area II is processed with the highest scan frequency, though substantially less scan density, area III is processed with high scan density, though lower scan frequency and area IV is processed with less scan density and less scan frequency. Fields I-IV are to be understood as clarification only, since those areas requiring different scan densities and different scan frequencies within a volume are distributed according to the respective structures.

1. A method for examining objects using ultrasound according to reflection processes, in particular with 3D scanning, wherein the respective object is scanned with a sound head unit **(1)** with associated send/receive unit **(2, 4)** appropriate for volume scanning and the obtained echoes are stored in a volume memory **(5)** in clear assignation to the local coordinates of the reflection locations, from which memory **(5)** they are accessed according to selectable accessing criteria and can be forwarded to an evaluation unit, in particular a display unit, characterised in that during scanning the spatial line density and/or the temporal repetition frequency, in which certain volume areas are scanned, is deflected by the contents of the information obtained or obtainable from these areas in such a form that areas having less information content are scanned more seldom and/or with less scanning density than areas having a higher information content, for which purpose a computer **(9-11)** is provided which ascertains details on the information content of these data records from data records received from the same local regions at different times, and/or controls a control unit used for adjusting the repetition frequency and/or the local scanning density, whereby the control unit determines the release sites of the individual scanning instances and their time.

2. Method as claimed in claim 1, characterised in that the temporal repetition frequency of the scanning is adjusted for the individual areas independently of the movement of the echo signals in the respective volume area.

3. Method as claimed in claim 1 or 2, characterised in that the local scan density is adjusted for the individual volume areas independently of the fineness of the echo structure in the respective area.

4. Method as claimed in claim 2, characterised in that the movement of the echo signals is calculated from the correlation of a data record recorded from the respective volume area with a later data record recorded particularly currently from the same volume area.

5. Method as claimed in claim 3, characterised in that the fineness of the echo structure is determined by frequency analysis.

6. Method as claimed in claim 4, characterised in that the data records are filtered before the correlation calculation is carried out.

* * * * *

patsnap

专利名称(译)	使用超声波检查物体的方法
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[标]申请(专利权)人(译)	KRETZTECHN AKTIENGES
申请(专利权)人(译)	Kretztechnik将AG
当前申请(专利权)人(译)	GE医疗系统Kretztechnik将GMBH＆CO OHG
[标]发明人	WIESAUER FRANZ
发明人	WIESAUER, FRANZ
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摘要(译)

在根据反射过程，特别是3D扫描使用超声波检查物体的方法中，利用声音头单元（1）扫描物体，声音头单元具有适合于体积扫描的相关发送/接收单元（2,4）和所获得的回声。数据以明确的方式存储在体积存储器（5）中，反映到反射点的局部坐标。在扫描期间，扫描某些体积区域的空间线密度和/或时间重复频率被从这些区域获得或可获得的信息的内容偏转，使得信息内容较少的区域被扫描的更少。和/或扫描密度小于具有较高信息内容的区域。