※Tomography 的原理

United States Patent 4,105,018

Greenleaf , et al. August 8, 1978

Acoustic examination, material characterization and imaging of the internal structure of a body by measurement of the time-of-flight of acoustic energy therethrough

Abstract

Pulses of acoustic energy are transmitted from a plurality of different directions through a plane of interest, or a number of adjacent planes of interest, of a body to be examined. The body may be biological or non-biological. Time-of-flight of the pulses is measured for individual paths through the body, and from the data thus obtained the spatial distribution of the acoustic velocity through the plane or planes within the body is reconstructed using a mathematical reconstruction technique. The velocity values thus obtained, which are uniquely determinative of the acoustic index of refraction at each point, have diagnostic value, and they can further be displayed by means of a cathode ray tube or other imaging device to provide an image of the internal structure along each plane. The disclosed technique has the advantage of being highly independent of acoustic attenuation and reflections occurring along the paths.

Inventors: Greenleaf; James F. (Rochester, MN); Johnson; Steven A. (Rochester, MN)

Assignee: University of Utah (Salt Lake City, UT)

※跟上一篇差不多

United States Patent 4,279,157

Schomberg , et al. July 21, 1981

Method of and device for determining the internal structure of a body by means of acoustic beams

Abstract

A method and device for determining the internal structure of a body by means of acoustic beams. Transit times and intensities of acoustic beams passing through the

body in different spatial directions are measured to establish the refractive index distribution and the acoustic absorption coefficient distribution, respectively at the points of a point matrix associated with the body. The non-rectilinear course of the acoustic beams is taken into account in this respect. This results in reconstructed images of higher quality.

Inventors: Schomberg; Hermann (Hamburg, DE); Tasto; Manfred (Henstedt-Ulzburg, DE)
Assignee: U.S. Philips Corporation (New York, NY)

※探頭掃瞄的裝置

United States Patent 4,509,368
Whiting , et al. April 9, 1985

Ultrasound tomography

Abstract

A method and apparatus for ultrasound tomography for use in clinical diagnostics, the apparatus comprising paired couples of transmission transducers (3) and reflection transducers (5,6), the paired couples of transducer means being independently operable within a container (1) of ultrasound transmission medium to provide data capable of processing by computational methods for mathematical reconstruction of the distribution of specific values of acoustic data to permit separate comparative and synergistic examinations of the data thus obtained to classify the internal structure of a body.

Inventors: Whiting; James F. (Indooroopilly, AU); Koch; Rolf H. L. (Bardon, AU)
Assignee: The Commonwealth of Australia (Australian Capital Territory, AU)

※把 control, filter, memory 等硬體架構做出來

United States Patent 4,549,265
Deckers , et al. October 22, 1985

Method of and device for image reconstruction in computed tomography

Abstract
A method and device for computer tomography in which the same filtering operation can be performed for the image reconstruction, regardless of the method used to measure the measured data. Before and after the filtering the data there is performed a multiplication by a pre-conditioning factor and a post-conditioning factor, respectively. The pre-conditioning and post-conditioning factors are dependent on the type of reconstruction and on the position of a data in the group of measured data. The fact that the same filter can be used is important notably for computer tomography apparatus in which a convolution filter is embodied in circuit hardware. The back-projection device is suitable for the back-projection of measured data along diverging measuring paths as well as measured data along parallel measuring paths with only modification of some constants.

Inventors: Deckers; Willem H. M. (Eindhoven, NL); Op de Beek; Johannes C. A. (Eindhoven, NL)
Assignee: U.S. Philips Corporation (New York, NY)

※減少取到數據受 artifact 的影響

United States Patent 4,829,430
Greenleaf , et al. May 9, 1989

Method for reducing artifacts in ultrasound backscatter tomography

Abstract
Sets of raw profile data are acquired from a subject using an ultrasound reflective mode tomographic scan. This raw data is corrected for errors due to inhomogeneities in the speed of sound and an image is reconstructed from the corrected data set. **The corrections are made by shifting each set of raw profile data such that a prominent signal therein aligns with a corrective sinusoid which indicates the ideal location of the prominent signal in each set of profile data.**

Inventors: Greenleaf; James F. (Rochester, MN); Ylitalo; Juha T. (Oulu, FI)
Assignee: Mayo Foundation for Medical Education and Research (Rochester, MN)

※演算法，parallel computation

United States Patent 5,047,931

Lin September 10, 1991

Parallel computation of fan-beam back-projection reconstruction algorithm in computed tomography

Abstract

Parallel accumulation of the density functions of image picture elements is done for a number of elements located at the same radial distance from the axis of rotation for the fan-beam scanner. This allows the computation of weighting factor to be done in common for these elements, as well as the computation of interpolation coefficients for ray sums not registering exactly with x-ray detectors.

Inventors: Lin; Wen-Tai (Schenectady, NY)

Assignee: General Electric Company (Schenectady, NY)

※用 speed of sound 來算樣本內的速度分佈

United States Patent 5,181,778

Beller January 26, 1993

Ultrasonic tomography for in-process measurements of temperature in a multi-phase medium

Abstract

A method and apparatus for the in-process measurement of internal particulate temperature utilizing ultrasonic tomography techniques to determine the speed of sound through a specimen material. Ultrasonic pulses are transmitted through a material, which can be a multi-phase material, over known flight paths and the ultrasonic pulse transit times through all sectors of the specimen are measured to determine the speed of sound. **The speed of sound being a function of temperature, it is possible to establish the correlation between speed of sound and temperature, throughout a cross-section of the material, which correlation is programmed into a computer to provide for a continuous in-process measurement of temperature throughout the specimen.**

Inventors: Beller; Laurence S. (Idaho Falls, ID)
Assignee: EG&G Idaho, Inc. (Idaho Falls, ID)

※用 array（synthetic four sides boundary scanner array）來 scan

United States Patent 5,318,028
Mitchell , et al. June 7, 1994

High resolution ultrasound mammography system and boundary array scanner therefor

Abstract

A synthetic four sides boundary scanner array is provided for an ultrasound mammography system. Projector and hydrophone elements are alternately disposed on the four array sides for stepped movement along the four sides during a scan of a breast volume. Electric signals generated by the hydrophone elements are processed to provide image data for displaying the breast volume. A breast scan is performed within the time between a patient's heartbeats.

Inventors: Mitchell; Bruce C. (Ellicott City, MD); James; Leslie M. (Severna Park, MD)
Assignee: Westinghouse Electric Corporation (Pittsburgh, PA)

※跟上面差不多，只是多加一點東西

United States Patent 5,433,202
Mitchell , et al. * July 18, 1995

High resolution and high contrast ultrasound mammography system with heart monitor and boundary array scanner providing electronic scanning

Abstract

A synthetic four sided boundary scanner has an electronically switched line array of transducer elements of transducer element on each side of a boundary array scanner, in an ultrasound mammography system. Projector and hydrophone elements are alternately provided in the four line arrays for randomized paired switching operation

during a scan of a breast subvolume. Electric signals generated by the hydrophone elements are processed to provide image data for the whole breast volume after sequenced scanning of the breast subvolumes is completed. A breast scan is performed in a sequence of periods within the time between a patient's heartbeats, with synchronization enabled by a heart monitor.

Inventors: Mitchell; Bruce C. (Ellicott City, MD); James; Leslie M. (Severna Park, MD)
Assignee: Westinghouse Electric Corporation (Pittsburgh, PA)

United States Patent 5,433,206
Sabbah , et al. July 18, 1995

System and a method for simultaneous, real time ultrasound imaging of biological tissue and measuring of blood flow velocity

Abstract
A system for simultaneous, real time imaging of biological tissue and measuring of blood flow velocities using the Doppler principle resulting in an improvement in Doppler power spectrum of the blood flow velocity measurements.

Inventors: Sabbah; Benjamin (Haifa, IL); Amara; Arie (Mitzpe Gillon, IL)
Assignee: Elscint, Ltd. (Haifa, IL)

※用兩條 beam 來做 helical（螺旋狀）的 scan, projection data from each fan beam measurement is weighted by weighting factors to obtain a reconstructed slice.

United States Patent 5,513,236
Hui April 30, 1996

Image reconstruction for a CT system implementing a dual fan beam helical scan

Abstract
The present invention, in one form, is an apparatus for performing image reconstruction using data obtained by a **dual beam helical scan**. **In reconstructing**

an image in accordance with the present invention, projection data from each fan beam measurement is weighted by weighting factors to obtain a reconstructed slice. The data arrays selected and weighting factors applied vary depending on the table speed and the detector spacing measured at the axis of gantry rotation, i.e., the detector z spacing.

Inventors: Hui; Hu (Waukesha, WI)
Assignee: General Electric Company (Milwaukee, WI)

※另一種 scan 方式（cone beam helical scan）

United States Patent 5,663,995
Hu September 2, 1997

Systems and methods for reconstructing an image in a CT system performing a cone beam helical scan

Abstract
A method for reconstructing an image in a computed tomography system performing a cone beam helical scan is described. In accordance with one embodiment, a point is selected for which image data is to be generated and a ray pair is identified wherein each ray passes through the selected point. Further, each ray in the ray pair is related according to view angle and detector angle associated with each ray. Projection data of each ray is then weighted to generate image data for the selected point.

Inventors: Hu; Hui (Waukesha, WI)
Assignee: General Electric Company (Milwaukee, WI)

United States Patent 5,603,326
Richter February 18, 1997

Method and apparatus for displaying an image obtained by echo signals

Abstract
In a method for imaging display of a spatially fixed subject with a primary (wave)

radiation directed onto the subject, particularly ultrasound, whereby the imaging display ensues with the echo signals received by an echo signal receiver on the basis of the transit time and/or amplitude thereof with reference to a subject axis directed in the spatial direction of the primary radiation, the subject is located between the primary radiation transmitter/echo signal receiver and a reference surface aligned perpendicular to the spatial direction of the primary radiation and that reflects the primary radiation as an echo signal more strongly than other regions of the subject situated in the field of presentation. The average or expected transit time and/or amplitude of an echo signal of primary radiation passing through the subject that is reflected from the reference surface and received by the primary radiation transmitter/echo signal receiver is calculated or predetermined as reference echo signal. The transit time and/or amplitude of an echo signal of the primary radiation passing through the subject reflected from the reference surface and received by the primary radiation transmitter/echo signal receiver is calculated. The deviation of echo signal reflected by the reference surface compared to the reference signal is evaluated.

Inventors: Richter; Kari (Berlin, DE)

Assignee: Siemens Aktiengesellschaft (Munich, DE)

※用 wavelet 來做 tomography

United States Patent 5,841,890

Kraske November 24, 1998

Multi-dimensional wavelet tomography

Abstract

Multi-dimensional wavelet tomography is performed by iteratively projecting a multi-dimensional image across a range of orientations so as to produce a plurality of one-dimensional projections which collectively form a projection image thereof; and then **performing wavelet decomposition upon the projection image thereof so as to form a plurality of projection subimages each containing particular boundary and angular characteristics of the original image.** Such wavelet decomposition facilitates segmentation and reconstruction of selected characteristics of the original image.

Inventors: Kraske; Wolfgang F. (Whittier, CA)

Assignee: Northrop Grumman Corporation (Los Angeles, CA)

※結合 Ultrasound 和 X-ray 的 tomography

United States Patent 5,983,123

Shmulewitz November 9, 1999

Methods and apparatus for performing ultrasound and enhanced X-ray imaging

Abstract

Apparatus is provided that combines radiography equipment with an ultrasonic transducer to generate ultrasonic images of the internal structure of biological tissue that are in registration with an X-ray image. The apparatus includes an examination table having a radiolucent and sonolucent window for imaging the biological tissue with an ultrasound and X-ray subsystems without moving the patient. In alternative embodiments, the ultrasound transducer may be an annular array transducer mounted on a moveable or a linear array of ultrasonic transducing elements. The X-ray images are preferably generated digitally using a line X-ray source and detector.

Inventors: Shmulewitz; Ascher (Mercer Island, WA)

Assignee: United States Surgical Corporation (Norwalk, CT)

※結合 Ultrasound 和 X-ray 來做 mammography

United States Patent 5,938,613

Shmulewitz August 17, 1999

Methods and apparatus for performing sonomammography and enhanced X-ray imaging

Abstract

Apparatus is provided that combines mammography equipment with an ultrasonic transducer to generate ultrasonic images of the internal structure of breast tissue that are in geometric registration with a mammogram. The apparatus includes a radiolucent and sonolucent compression plate, and in alternative

embodiments, a gantry driven ultrasound transducer or a phased array ultrasonic transducer. Methods are provided for generating a mammogram and a plurality of corresponding ultrasound images without moving the breast between the mammogram exposure and the ultrasound imaging. Methods are also provided for viewing and analyzing the ultrasound images. Apparatus and methods are also provided for enhancing X-ray images obtained from conventional mammographic systems, and with reduced overall X-ray dosage to the patient.

Inventors: Shmulewitz; Ascher (Seattle, WA)

Assignee: United States Surgical Corporation (Norwalk, CT)

※結合 ultrasound tomography 來確保組織切片儀器的使用安全

United States Patent 6,027,457

Shmulewitz , et al. February 22, 2000

Apparatus and method for securing tissue during ultrasound examination and biopsy

Abstract

An ultrasound imaging and biopsy system is provided in which an upper compression member of the system includes a thin, flexible, sterile and disposable membrane that compresses the tissue and permits a biopsy instrument to be readily inserted therethrough. In a preferred embodiment, a table is provided that houses an ultrasound scanning system beneath a sonolucent window forming a lower compression surface. Methods of using the system to perform real-time image-guided biopsy of tissue disposed on the window are also provided.

Inventors: Shmulewitz; Ascher (Mercer Island, WA); Crosby; Peter A. (Bellevue, WA)

Assignee: United States Surgical Corporation (Norwalk, CT)

※集大成，3D reconstruction

United States Patent 6,324,241

Besson November 27, 2001

Method and apparatus for CT reconstruction

Abstract

In one embodiment, the present invention is a method for reconstructing a scanned CT image that includes steps of: acquiring projection data of an object utilizing a flat-panel detector; and filtering and backprojecting the projection data, without radially interpolating, to reconstruct a three-dimensional image of the object. This embodiment provides direct fan-parallel, three-dimensional reconstruction of computed tomographic images without loss of resolution associated with radial interpolation, while retaining imaging quality and backprojection speed gains associated with parallel reconstruction.

Inventors: Besson; Guy M. (Wauwatosa, WI)

Assignee: GE Medical Systems Global Technology Company, LLC (Waukesha, WI)