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(54) **High resolution 3D ultrasound imaging system deploying a multi-dimensional array of sensors and method for multi-dimensional beamforming sensor signals**

(57) An adaptive multidimensional beamformer having near-instantaneous convergence for ultrasound imaging systems deploying multidimensional sensor arrays is disclosed. In a first step, the multidimensional beamformer is decomposed into sub-apertures. Each sub-aperture is then again decomposed into two coherent subsets of circular and/or line array beamformers in different coordinate directions of the multidimensional array. Implementation of the multidimensional beamformer according to the present invention provides the basis for a 3D ultrasound imaging system according to the present invention comprising a compact multidimensional sensor array and a compact processing unit that is field deployable and generates high resolution three-dimensional images in real time. It is also possible to capture four-dimensional images, the fourth dimension being time and the resulting images forming a video image of a volume of a moving organ.

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EUROPEAN SEARCH REPORT

Application Number
EP 00 12 4987

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 98/34294 A (TERATECH CORPORATION; GILBERT, JEFFREY, M; CHIANG, ALICE, M; BROADSTON) 6 August 1998 (1998-08-06) * page 4, line 12 - line 34 * * page 5, line 14 - line 20 * * page 26, line 8 - line 12 *	1,2,5-7, 10,11, 25,26,29	INV. G10K11/34
A		3,4,8,9, 12-24, 27,28,30	
A	----- US 4 544 927 A (KURTH ET AL) 1 October 1985 (1985-10-01) * column 9, line 17 - line 41 *	12,20	
A	----- US 5 027 820 A (PESQUE ET AL) 2 July 1991 (1991-07-02) * claim 3; figure 1 *	1,3,12, 14,20,27	
A	----- US 3 370 267 A (BARRY HARRY J) 20 February 1968 (1968-02-20) -----		
			TECHNICAL FIELDS SEARCHED (IPC)
			G10K G01S
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 August 2006	Examiner Swartjes, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 4987

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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07-08-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9834294	A	06-08-1998	AU 743355 B2	24-01-2002
			AU 6937398 A	25-08-1998
			CA 2279291 A1	06-08-1998
			CN 1260070 A	12-07-2000
			EP 0956611 A2	17-11-1999
			JP 2001511250 T	07-08-2001
			TW 426805 B	21-03-2001
			US 6292433 B1	18-09-2001
			US 6111816 A	29-08-2000

US 4544927	A	01-10-1985	NONE	

US 5027820	A	02-07-1991	DE 68907694 D1	26-08-1993
			DE 68907694 T2	10-02-1994
			EP 0368418 A1	16-05-1990
			FR 2638884 A1	11-05-1990
			JP 2183189 A	17-07-1990
			JP 2851005 B2	27-01-1999

US 3370267	A	20-02-1968	SE 326390 B	20-07-1970

专利名称(译)	高分辨率3D超声成像系统，其部署多维传感器阵列和用于多维波束形成传感器信号的方法		
公开(公告)号	EP1103950A3	公开(公告)日	2006-09-13
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[标]申请(专利权)人(译)	国防部		
申请(专利权)人(译)	女王陛下在右加拿大为代表由国防部部长		
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CPC分类号	G01S15/8927 G01S7/52046 G01S15/8929 G01S15/8993 G10K11/346 Y10S128/916		
优先权	2290240 1999-11-24 CA		
其他公开文献	EP1103950A2		
外部链接	Espacenet		

摘要(译)

公开了一种自适应多维波束形成器，其具有用于部署多维传感器阵列的超声成像系统的近瞬时会聚。在第一步骤中，多维波束形成器被分解成子孔径。然后，每个子孔径再次分解成在多维阵列的不同坐标方向上的圆形和/或线阵列波束形成器的两个相干子集。根据本发明的多维波束形成器的实现为根据本发明的3D超声成像系统提供了基础，该3D超声成像系统包括紧凑的多维传感器阵列和可现场部署并且实时生成高分辨率三维图像的紧凑处理单元。。还可以捕获四维图像，第四维度是时间，并且得到的图像形成运动器官的体积的视频图像。

European Patent Office		EUROPEAN SEARCH REPORT		Application Number EP 00 12 4987
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A	US 5 027 820 A (PESQUE ET AL) 2 July 1991 (1991-07-02) * claim 3; figure 1 *	12,20		
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			TECHNICAL FIELD OF SEARCHED	
			G10K G01S	
The present search report has been drawn up for all claims.				
Place of search		Date of completion of the search	Examiner	
The Hague		7 August 2006	Swartjes, H	
CATEGORY OF CITED DOCUMENTS				
1. priority or parent document, if any, above 2. priority or parent document, if published on, or after the filing date 3. document cited in the application 4. document cited for other reasons 5. document cited for other reasons 6. member of the same patent family, corresponding document 7. document cited for other reasons 8. document cited for other reasons 9. document cited for other reasons 10. document cited for other reasons 11. document cited for other reasons 12. document cited for other reasons 13. document cited for other reasons 14. document cited for other reasons 15. document cited for other reasons 16. document cited for other reasons 17. document cited for other reasons 18. document cited for other reasons 19. document cited for other reasons 20. document cited for other reasons 21. document cited for other reasons 22. document cited for other reasons 23. document cited for other reasons 24. document cited for other reasons 25. document cited for other reasons 26. document cited for other reasons 27. document cited for other reasons 28. document cited for other reasons 29. document cited for other reasons 30. document cited for other reasons 31. document cited for other reasons 32. document cited for other reasons 33. document cited for other reasons 34. document cited for other reasons 35. document cited for other reasons 36. document cited for other reasons 37. document cited for other reasons 38. document cited for other reasons 39. document cited for other reasons 40. document cited for other reasons 41. document cited for other reasons 42. document cited for other reasons 43. document cited for other reasons 44. document cited for other reasons 45. document cited for other reasons 46. document cited for other reasons 47. document cited for other reasons 48. document cited for other reasons 49. document cited for other reasons 50. document cited for other reasons 51. document cited for other reasons 52. document cited for other reasons 53. document cited for other reasons 54. document cited for other reasons 55. document cited for other reasons 56. document cited for other reasons 57. document cited for other reasons 58. document cited for other reasons 59. document cited for other reasons 60. document cited for other reasons 61. document cited for other reasons 62. document cited for other reasons 63. document cited for other reasons 64. document cited for other reasons 65. document cited for other reasons 66. document cited for other reasons 67. document cited for other reasons 68. document cited for other reasons 69. document cited for other reasons 70. document cited for other reasons 71. document cited for other reasons 72. document cited for other reasons 73. document cited for other reasons 74. document cited for other reasons 75. document cited for other reasons 76. document cited for other reasons 77. document cited for other reasons 78. document cited for other reasons 79. document cited for other reasons 80. document cited for other reasons 81. document cited for other reasons 82. document cited for other reasons 83. document cited for other reasons 84. document cited for other reasons 85. document cited for other reasons 86. document cited for other reasons 87. document cited for other reasons 88. document cited for other reasons 89. document cited for other reasons 90. document cited for other reasons 91. document cited for other reasons 92. document cited for other reasons 93. document cited for other reasons 94. document cited for other reasons 95. document cited for other reasons 96. document cited for other reasons 97. document cited for other reasons 98. document cited for other reasons 99. document cited for other reasons 100. document cited for other reasons				