Ultrasonic Strain Image Made by Speckle Traction of B-mode Image

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Introduction

- For centuries, physicians have used palpation to detect abnormal regions
- Certain type of tissues have elastic properties that are markedly different from surrounding tissues
- Elasticity imaging can provide a significant adjunct to current diagnostic ultrasonic methods

Historical Review

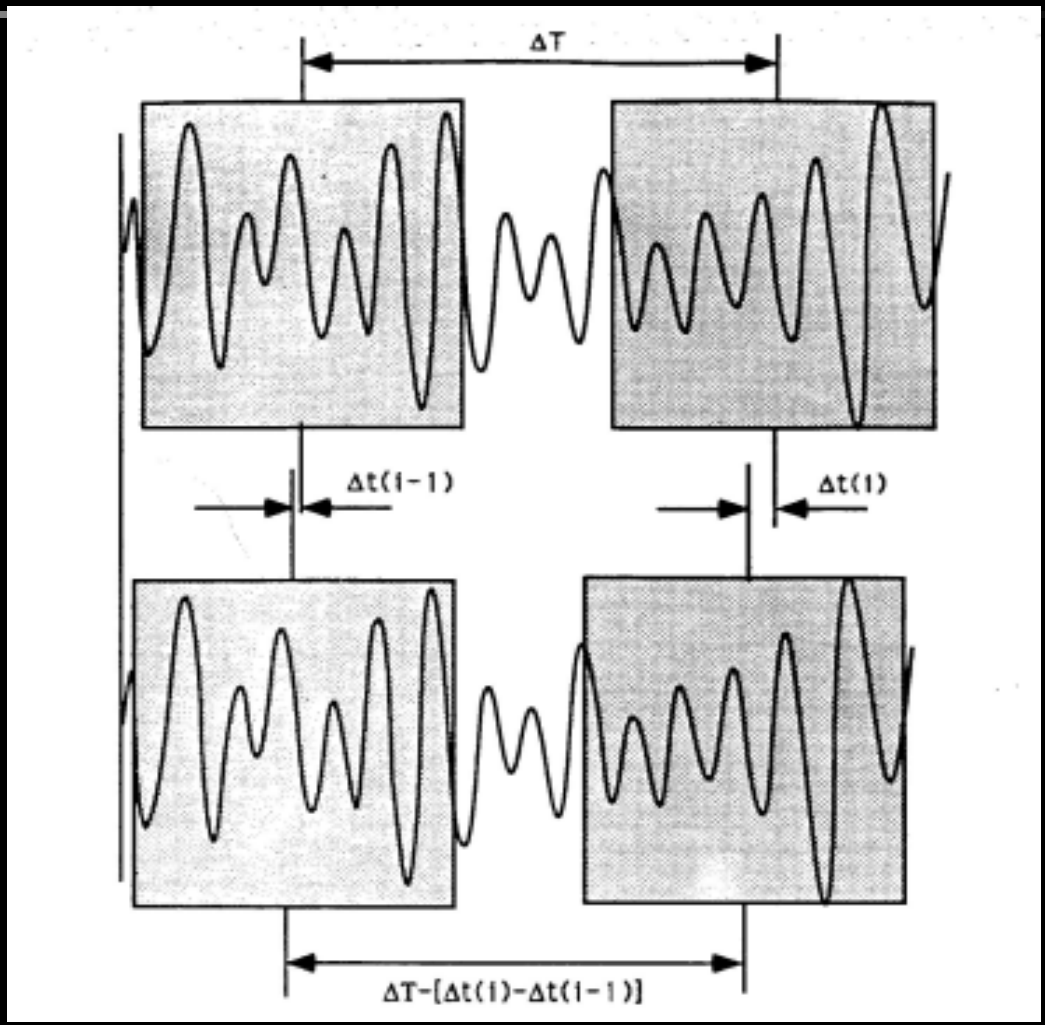
- Vibration sonoelastography: Lerner and Parker(1987)
- Compression strain sonoelastography: Ophir et al (1991)
- Multiple step compression strain sonoelastography: O'Donnell (1994)
- Inherent strain sonoelastograph: Bertrand et al. (1989)
- Block matching algorithm to derive elasticity information: Levinston et al. (1994)

Strain Estimation

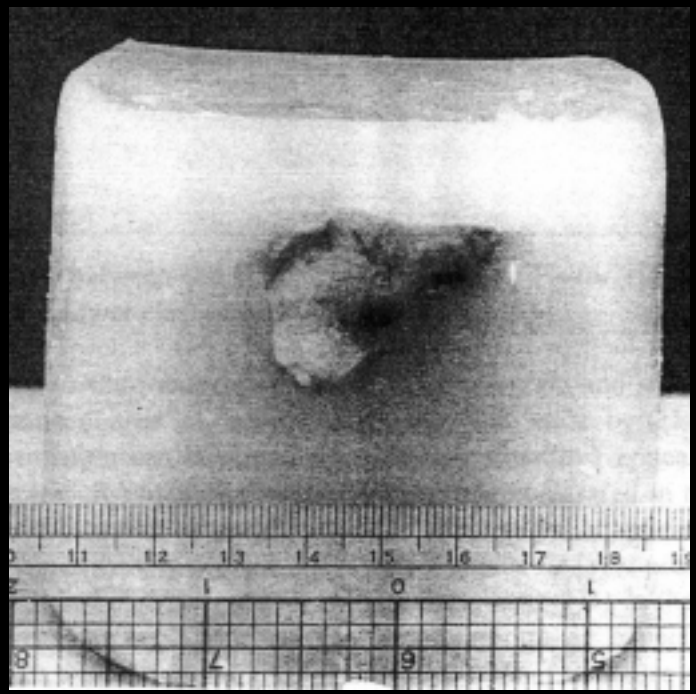
- Cross correlation of consequent A-line
  - RF data (Ophir, 1993)
  - Baseband data (O'Donnell, 1994)
- Speckle tracking of B-mode image
  - Block matching algorithm (Levinston, 1994; Yeung, 1997)

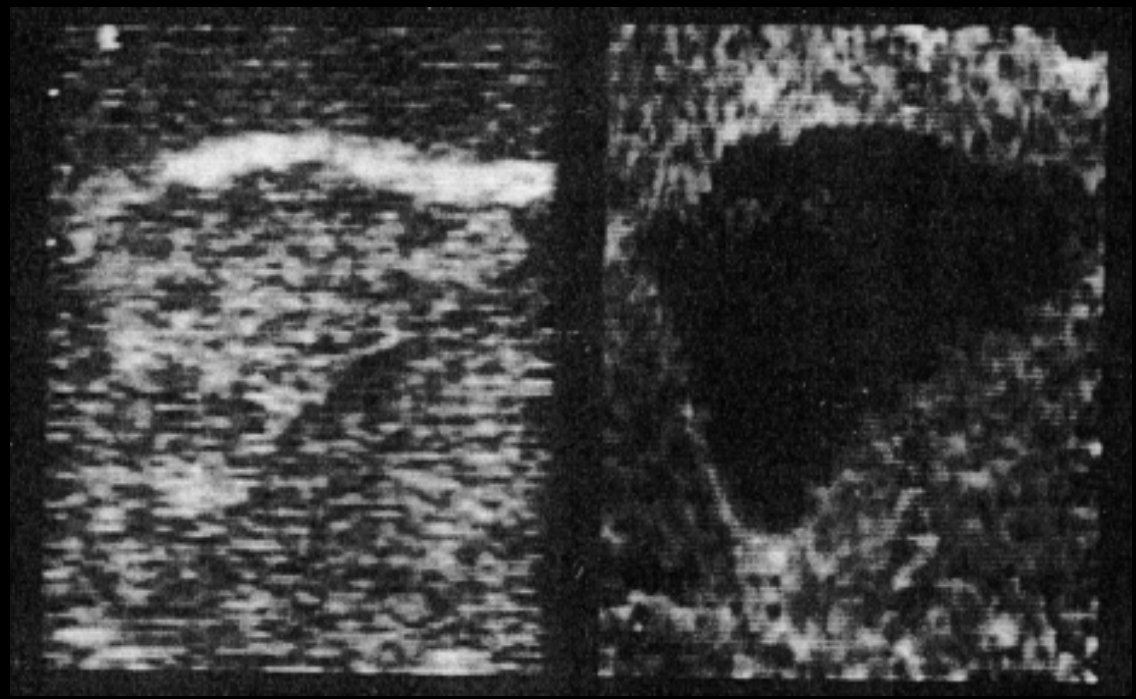
Strain Estimation by RF data

$$s(i) = \frac{\Delta t(i) - \Delta t(i-1)}{\Delta T}$$



Strain Image
- Breast cancer in Phantom

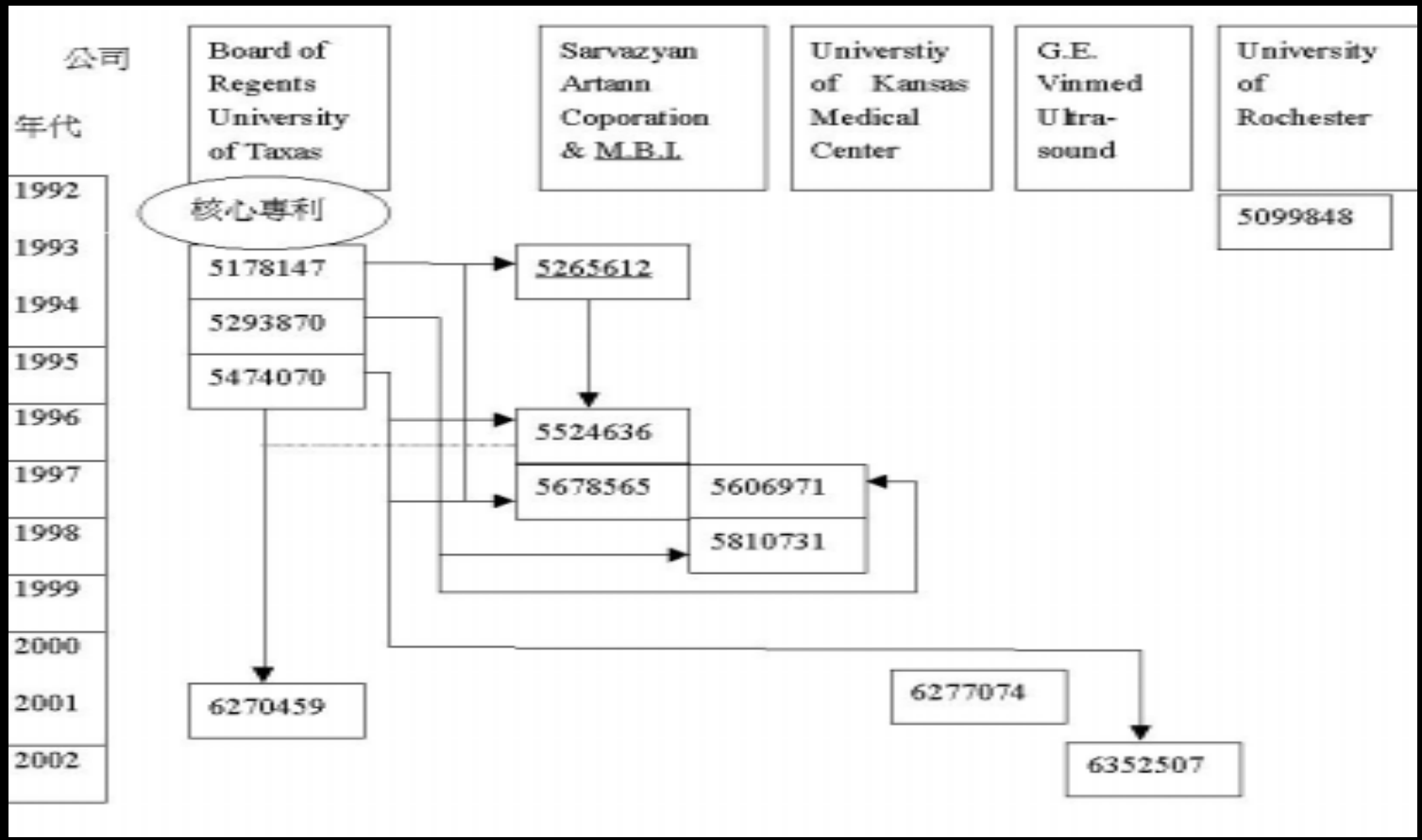




專利請求保護的範疇 (Elasticity Imaging)

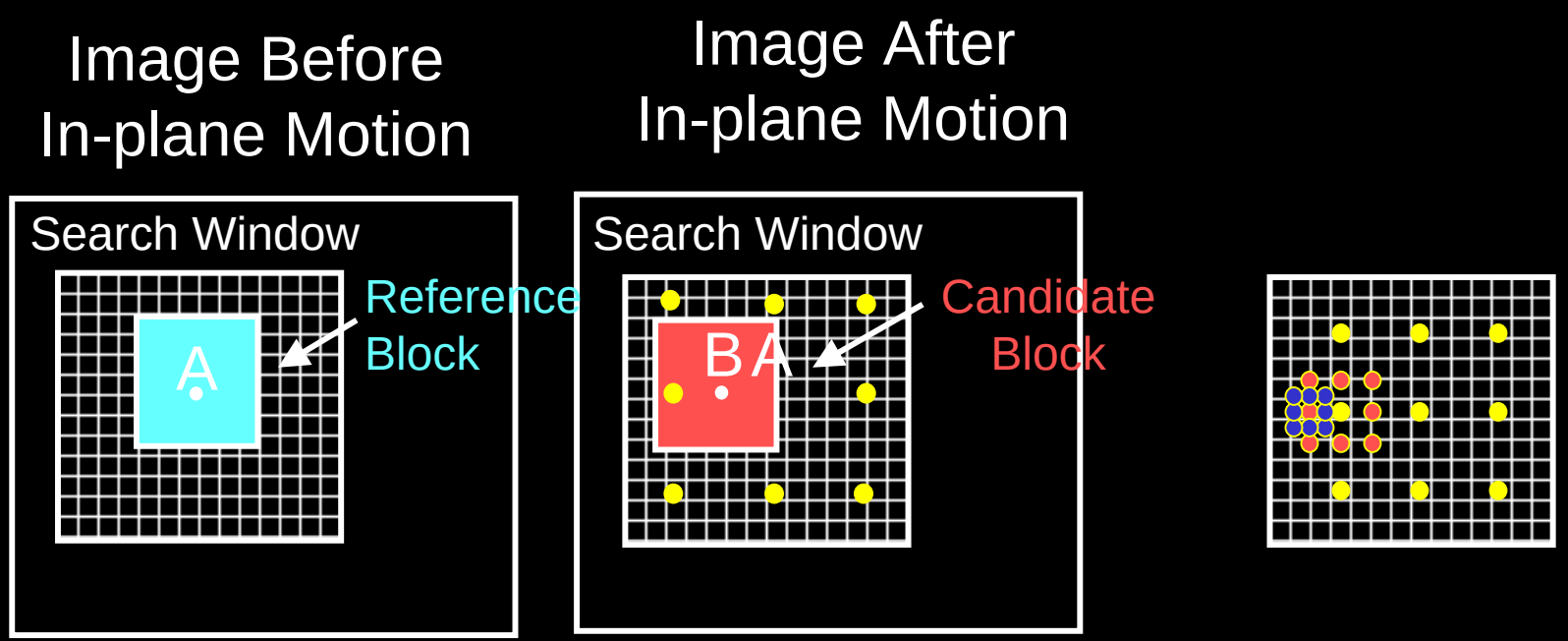
一階分類	二階分類	Device	Method	Apparatus	System	Process	小計	合計
Compression strain image	Compressibility		5178174	5178174			6	16
			5293870	5293870				
			5474070	5474070				
	intracavity	5265612					1	
	Tissue deformation		6352507		6352507		2	
	Motion estimation		6277074	6277074			2	
	Stress estimation		5524676	5524676			4	
		5678565	5678565					
	Lateral elastogram		6270459				1	
Vibration strain image					5099848		5	5
		5606971	5606971					
		5810732	5810732					

引證族譜圖(Elasticity Imaging)



Improved Speckle Tracking - Multi-level

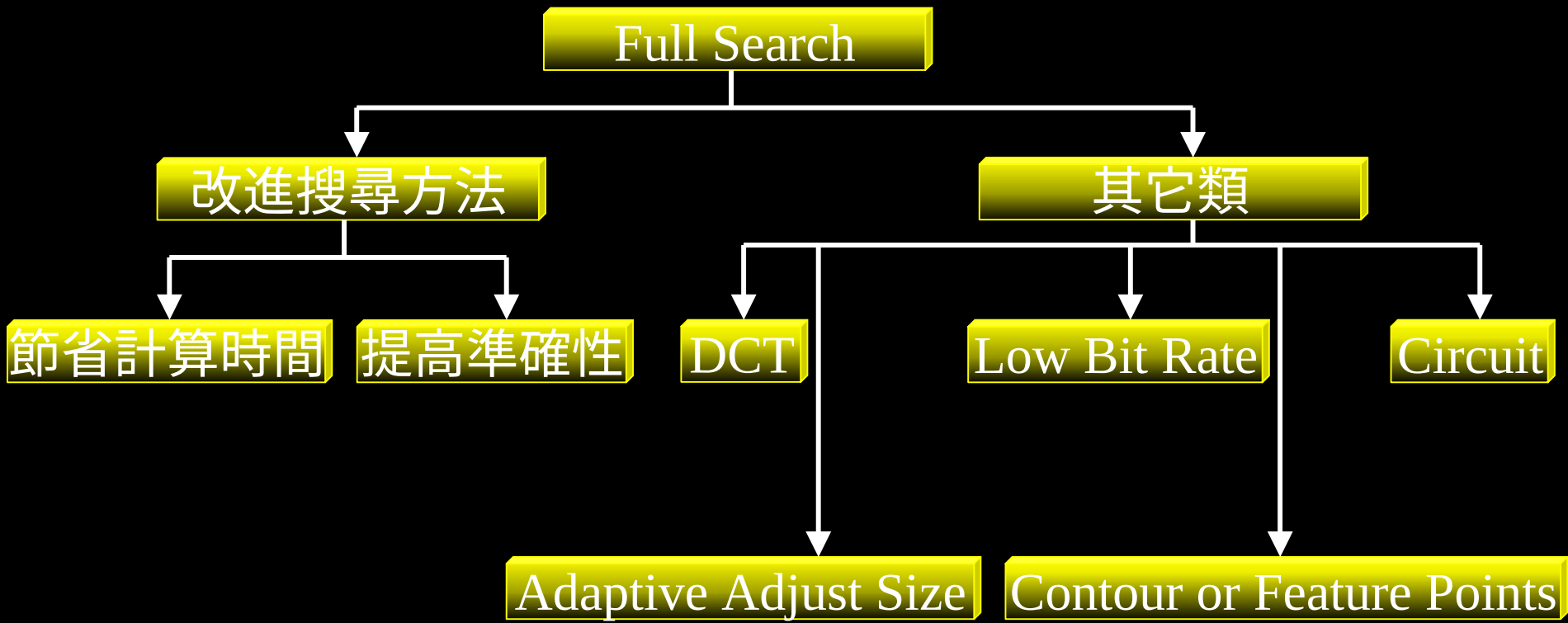
- 3 levels, 9 points estimation in each level



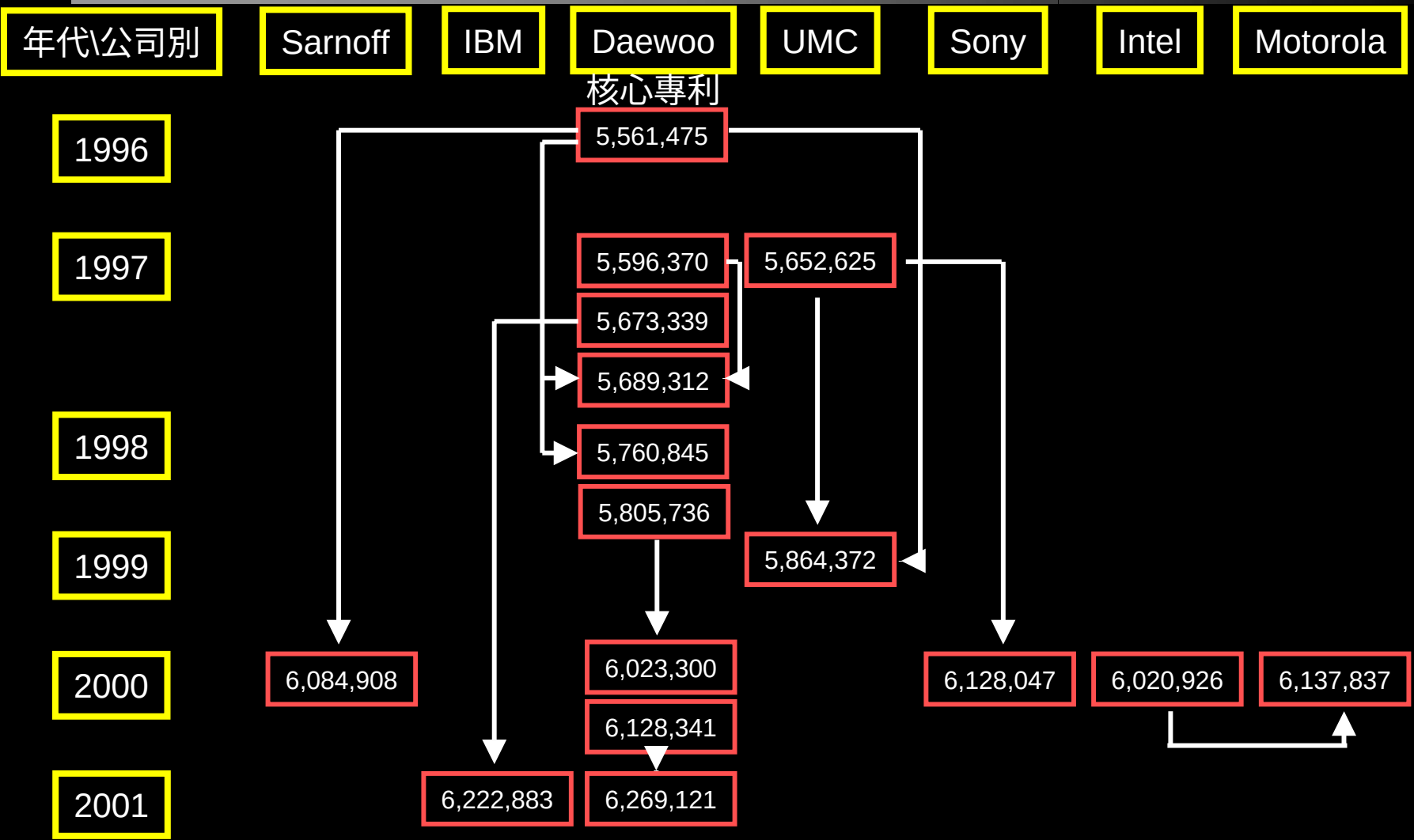
專利請求保護的範疇 (Speckle Tracking)

	Circuit	Method	Apparatus	System	合計
簡省計算時間	1	18	4	3	26
提高準確性	0	6	1	0	7
其它類	9	57	37	19	122
合計	10	81	42	22	155

技術的演進(Speckle Tracking)



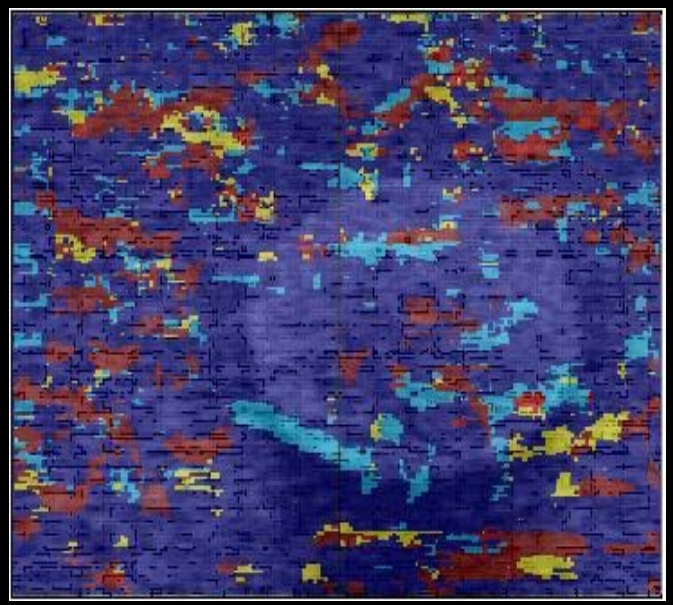
引證族譜圖(Speckle Tracking)

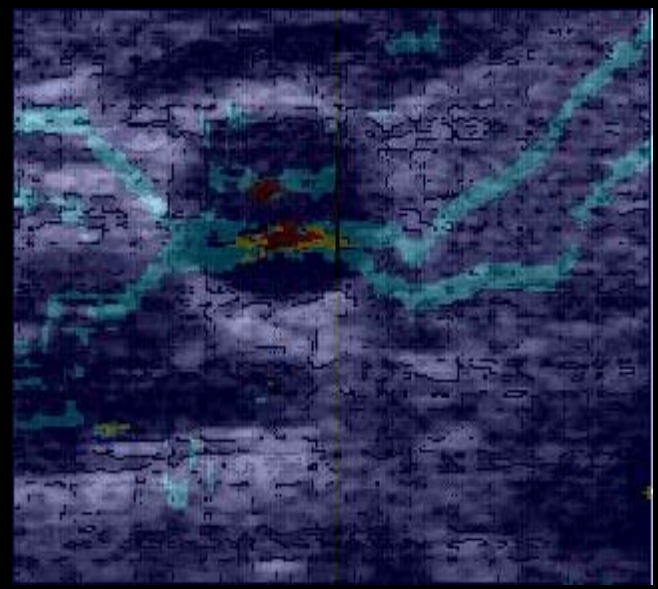


Material and Method

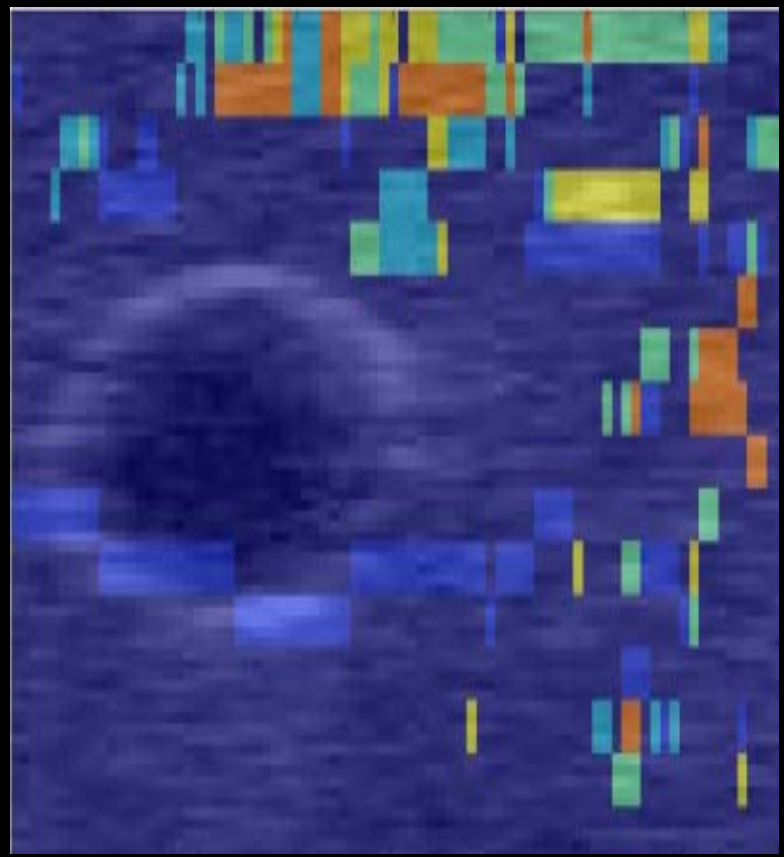
- Target of study: breast tumor and heaptic tumor
- .Strain estimation by speckle tracking
  - Block matching algorithm-multi-level
- .Elasticity Imaging:
  - Axial elastogram: segment: 35-40 pixels/10mm, 2-3mm per segments
  - Lateral elastogram
- Analysis of interface of tissue structure and boundary condition

Strain image
- sponge ball and thyroid

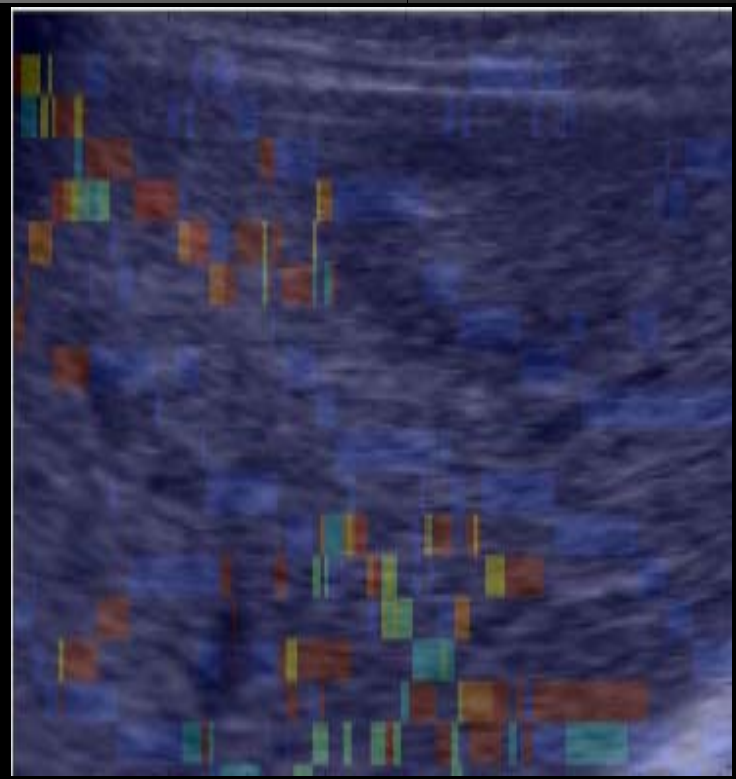




Strain image
- Cystic lesion in breast phantom



Strain image
- Hepatic tumor



References

- Yong-Sheng Chen, Yi-Ping Hung, Chiou-Shann Fuh ，Fast Block Matching Algorithm Based on the Winner-Update Strategy ，IEEE Trans on Image Processing 2001；10 (8): 1212-1222.
- Yeung F, Levinson SF, Parker KJ. Multiplevel and motion model-based ultrasonic Speckle tracking algorithms. Ultrasoud in Med. & Biol 1998; 24(3): 427-441.
- Gao L, Parker KJ, Lerner RM, Levinson SF. Imaging of the elastic properties of tissue-a review. Ultrasoud in Med. & Biol 1996; 22(8): 959-977.
- Ophir J, Cespedes I, Ponnekanti H, yazdi Y, Li X. Elastography: a quantatative method for imaging the elastocity of biological tissures. Ultrasonic imaging 1991; 13;111-134.
- O'Donnell M, Skovoroda AR, Shapo BM, Emelianov SY. Internal displacement and strain imaging using ultrasonic speckle tracking. IEEE Trans. Ultrason. . Ferroelect Freq. Contr. 1994;41(3):314-325.