



Third Meeting of the Imaging Technologies for the Skin
October 28th, 2010

RESEARCH AND DEVELOPMENT IN ULTRASOUND IMAGING

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OUTLINES

- Ultrasound and imaging within INSERM U930
- The skin within INSERM U930
- Pathology/Cosmetology and tissue elasticity
Elastography techniques
Elastography and the skin investigation

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ULTRASOUND AND IMAGING WITHIN INSERM U930

Director: Pr. D. Guilloteau

Neuroimaging

High-resolution US imaging

US contrast imaging

Elastography

New US transducer technologies

Eye

Liver

3

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 October 28th, 2010

THE SKIN WITHIN INSERM U930

High Resolution US Imaging at 20 and 50 MHz

- Blood *in-vitro*
- Skin *in-vivo*
- Eye *in-vivo*

Echo-morphology:

- Skin characterization at 20 & 50 MHz
- Skin pathologies: lymphedema, cancer

Echo/Parametric:

- Acoustic parameters
- Mechanical properties (Elastography)

Partners

- Dermatology: - CHU of Tours: - CIC IT Ultrasons (Pr. F. PATAT)
 - Dermatology service (Pr. L. MACHET)
- Cosmetology: LVMH, Pierre Fabre, Pacific creation and Spin control
- Imaging system: AtyS medical and Vermon

4

PATHOLOGY/COSMETOLOGY AND TISSUE ELASTICITY



www.idealfitness-reims.com

- Thyroid palpation**
- Hard or soft ?
 - Nodules ?
 - Regular contours ?



www.hepatoweb.com

- Liver palpation**
- Soft : Steatosis ?
 - Firm : Fibrosis ?
 - Hard : Cirrhosis ?
 - Wood : Cancer ?



- Skin palpation**
- Stress ?
 - Dermatology
 - Skin aging

Palpation



Soft / Hard ?

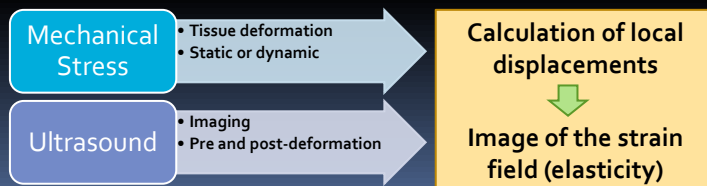


Diagnosis
 or
 cosmetic study

ULTRASOUND AND TISSUE ELASTICITY ESTIMATION

	Doctor	Ultrasonic device
Palpation	<ul style="list-style-type: none"> • Hand 	<ul style="list-style-type: none"> • Acoustic probe • Acoustic radiation
Soft / hard ?	<ul style="list-style-type: none"> • Sense of touch : sensor • Brain : estimates the elasticity 	<ul style="list-style-type: none"> • Ultrasonic probe : sensor • Ultrasound + algorithm : imaging of strain field in tissues
Diagnosis	<ul style="list-style-type: none"> • Subjective • Superficial tissues 	<ul style="list-style-type: none"> • Objective • Superficial and deep tissues

Elastography :



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ULTRASOUND AND TISSUE ELASTICITY ESTIMATION

US imaging

SOFT

HARD

Ultrasound image

US imaging

+ Stress ?
→ to deform tissues

Elastogram

SOFT

HARD

7

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ELASTOGRAPHY TECHNIQUES

US imaging

Freehand compression (2%)

Soft

Hard

Quasi-static elastography

Ultrafast US imaging

Acoustic radiation force
→ vibration

Dynamic elastography

Ultrafast US imaging (TM-mode)

Mechanical vibration

Transient elastography

SOFT

HARD

Average estimation of through-thickness elasticity

8

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ELASTOGRAPHY IN ULTRASOUND SYSTEMS



HI VISION 900:
 Quasi-static

www.hitachimed.com

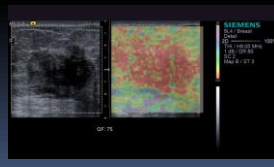


Breast, Thyroid, Liver



AcuSon S2000:
 Dynamic

www.swe.siemens.com

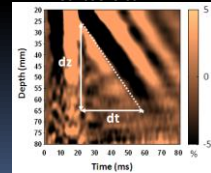


Endovaginal, breast



Fibroscan 502:
 Transient

www.echosens.com



Shear wave in liver

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DERMICUP

www.atysmedical.com

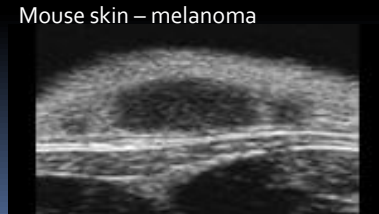


Human skin- Healthy, carcinoma,
 keratosis, angioma



Vevo 2100

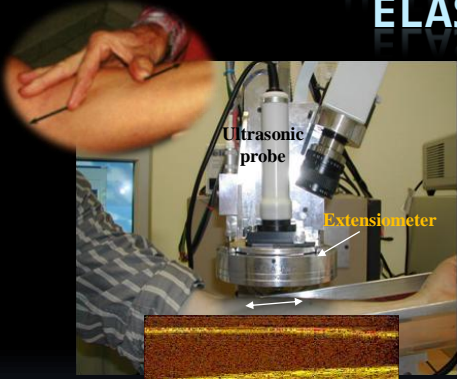
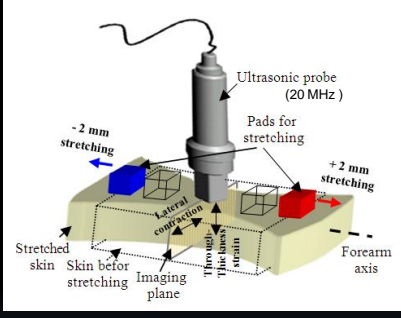
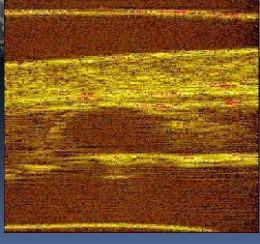
www.visualsonics.com



Mouse skin – melanoma

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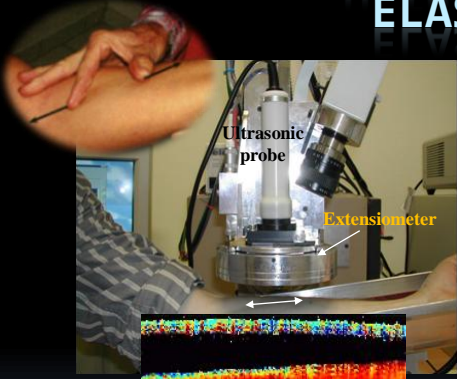
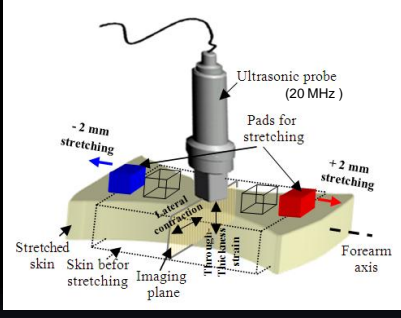
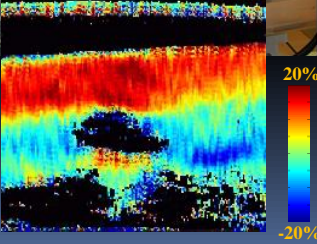
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11

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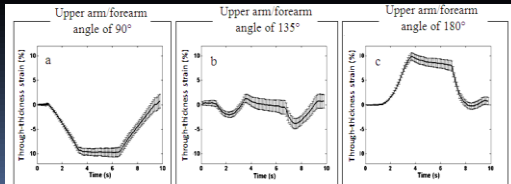
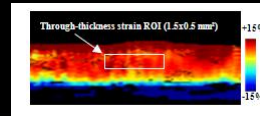
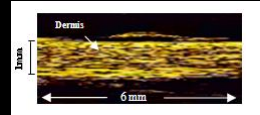
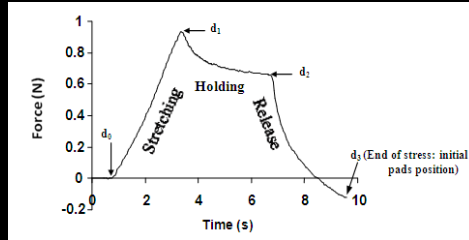
→ Thickening of the dermis
→ Thinning of the hypodermis

Y.Mofid & al, IEEE UFFC 2006

11

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Healthy skin – Mechanical properties → Aging ?

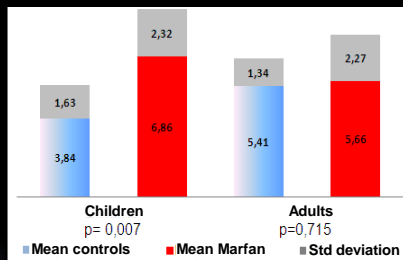


Stretched (20%) dermis:
 → Thinning
 → Thinning & thickening
 → Thickening

Y.Mofid & al, J. of Biomechanics 2010₁₂

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Clinical study - Marfan syndrome



Through-thickness strain parameter

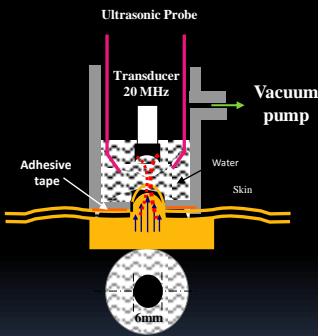


Marfan syndrom diagnosis for children

S. Gahagnon & al, IEEE Ultrasonics symposium 2009

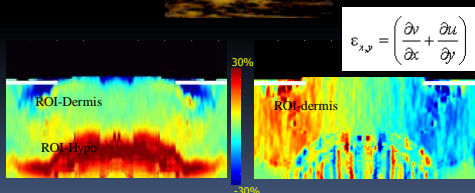
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Ultrasonic Probe
Transducer 20 MHz
Vacuum pump
Adhesive tape
Water
Skin
6mm
Suction stress

Edges of circular aperture

$$\epsilon_{x,y} = \left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y} \right)$$


ROI-Dermis
ROI-Hypo
ROI-dermis
30%
-30%

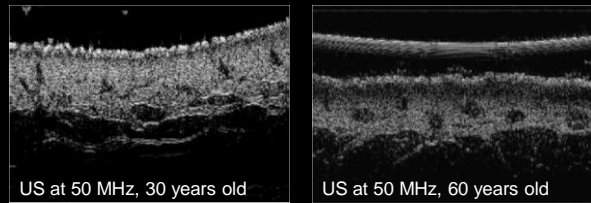
Y.Mofid & al, IEEE Ultrasonics symposium 2006

14

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CONCLUSION

- **Acoustic characterization at 20 and 50 MHz**



US at 50 MHz, 30 years old
US at 50 MHz, 60 years old

➔ 3D High resolution ultrasound imaging

- **Elastography**
- New knowledge of mechanical behavior of human skin
- New parameters for cosmetic studies
- A new diagnosis aid tool for dermatology

15



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THANK YOU VERY MUCH

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