





ORION Concept **COSM'@** **TECHNI@**

IN COSMETICS 2009




INNOVATIVE IMAGING OF THE SKIN
METHOD DEVELOPMENTS - APPLICATIONS & VALIDATION
FOR RESEARCH AND SKIN CARE PRODUCTS EFFICACY

*See to understand...
... Show to convince*

Environment *Digital Imaging* *Fringes Projection 3D* *DynaSkin* *Combined Techniques* *High Resolution Echography 3D* *Confocal Microscopy*












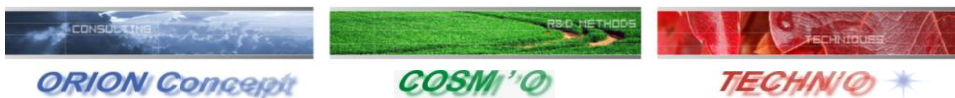
ORION Concept **COSM'@** **TECHNI@**

Tours, France **Orléans, France** **Tours, France**

Environment ...

- ✓ **Consultancy, Expertise, Training on New Techniques/Methods and Special Protocols**
- ✓ **Laboratory for the development, the validation and use of new methods and techniques for the study of the skin and the efficacy of skin care product (High technologies for imaging)**
 - Collaborations and partnerships
 - Validation of techniques & Methods
 - Validation of products with increase value techniques
 - Skin research
- ✓ **Sales of « Packages » (Materials, softwares, Training&Support)**
 - Materials for data acquisitions
 - Validated softwares for quantifications
 - Installations, Training and Support for users...

A network of competences for each projects



Networking for increase performances :

- Design & Developments of methods
- Their validation
- Their use in routine
- Their distributions & sales

DIIP Association ...



Digital photography

To quantify what we see...

- ✓ Quantification by image analysis with a validated software (FrameScan V02 – Orion Concept)
- ✓ Imaging use by the « marketing »
- ✓ Parametric and reconstructed images containing a large information

Remarque :

- ✓ Not so easy to involve ...
- ✓ High performances but only under controlled conditions





Digital photography

Quantifications on photographs

- ✓ **Color** (Product or skin)
- ✓ **Homogeneity** (Skin complexion, make-up products, ageing....)
- ✓ **Detection and quantification of different elements onto the skin** (Pigmentary spots, telangiectasies, wrinkles and their density, acne lesions, hairs ...)
- ✓ **Measurements of lashes** (Real and apparent length, width, volume and curvature)
- ✓ **Visibility of wrinkles** (On pseudo photographs)



...On parametric reconstructed images (Spectroscopic images)

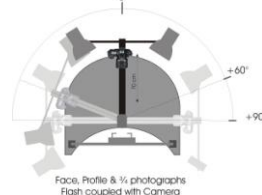
- ✓ **Selective quantifications on only one component of the skin** (Vascularisation or pigmentation)



Digital photography

Tool to control the ACQUISITION

HeadScan® V02



- ✓ Perfect repositioning of the subject
- ✓ Real 180° angles for acquisitions
- ✓ Coupling of : light/captor*/subject
- ✓ Stability of the acquisition parameters
- ✓ Calibration
- ✓ Modular

*Captor : Camera, video camera for dynamic acquisitions, Fringe projection captor...





Digital photography **FrameScan® V03**

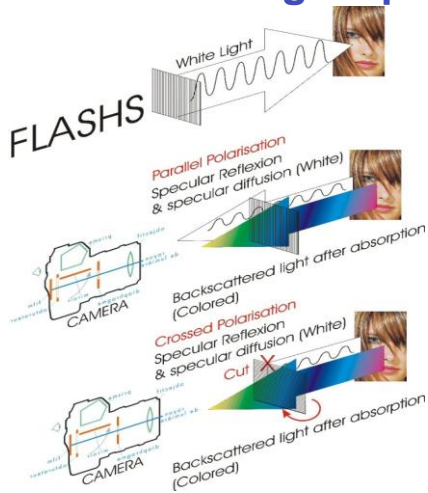
Tool for ANALYSIS

- Files Coding (Subject, Site, Time...)
- Tracability
- Protection of raw data
- Kinetics analysis
- All Parameter setting adjustable & protected by password
- Color Calibration
 - Calculation of color variations
 - Correction of small shifts
- Creation and storage of images for analysis (R, G, B channels, grey level, brightness...)
- Multi-formats : TIF, BMP, JPEG
- Management of images modalities crossed and parallel polarized light acquisitions...
- Processing « Step by Step »
- User guide
- Compilation and recording (file txt) to all individual results (Excel)



Digital photography **FrameScan® V03**

Crossed and parallel polarized light



Parallel : Brightness + Color
Crossed : Only color





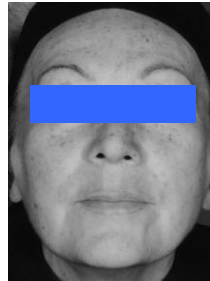
Digital photography

FrameScan®V03



Crossed polarized

Red : High homogeneity of the skin – Usefull for lashes and hair evaluations



Red Channel



Green Channel

Bleu : High contrast for pigmentary and vascular elements onto the skin



Blue Channel

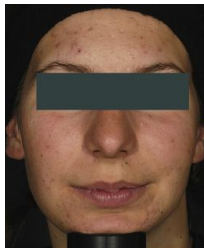
RGB channel separation



Digital photography

FrameScan®V03

Reconstructed parametric images



Acquired Image
(Crossed polarized image)



Pigmentation



Vascularisation



Contrast

Separation of different components of the skin

QUANTIFICATIONS :

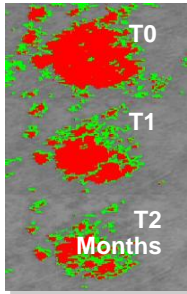
- Intensity, size, homogeneity, distribution, density (Acne, telangiectasies, complexion, pigmentation, spots ...)
- Multi-area measurements (Local & Global cartography)
- "Contrast of the face" – Perception of the relief and ptosis (Cutaneous slackening)



Digital photography

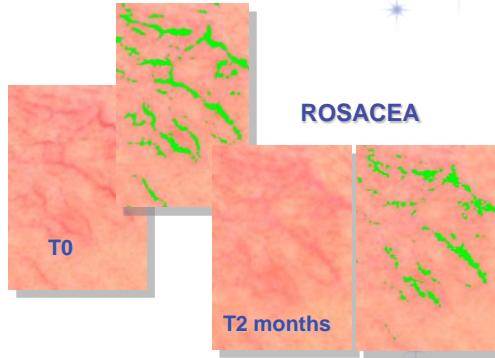
FrameScan®V03

Exemples



PIGMENTARY SPOTS

- Color (L*a*b*) versus skin
- Morphology (surface, perimeter, edge regularity, contrast, visibility...)
- Homogeneity



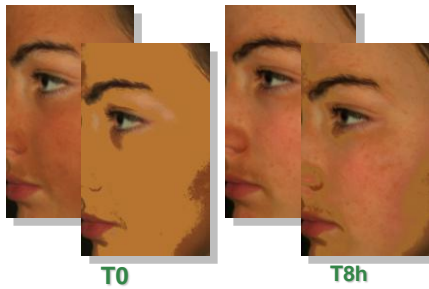
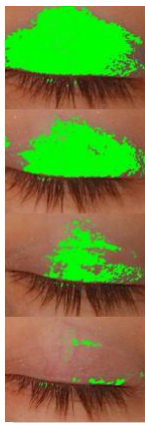
ROSACEA

- Number, surface, length
- Color

Digital photography

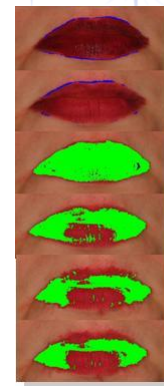
FrameScan®V03

Exemples



T0

T8h



- Follow-up of the make-up behavior in time (selective sorting of pixels : « product pixels/skin pixels”)
- Foundation cream, eye liner, mascara, lipstick, ...



Digital photography

FrameScan®V03



Acquired image
(crossed polarized)



Red channel

Exemples



Perceived Length
Without product



Real length
Without product

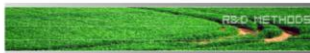


Real length
WITH product

QUANTIFICATIONS : With "active contours"

- Real & Apparent Length, width (Validated correlation with the clinical evaluation)

-Number, crossings (parallelism of lashes) , aggregates (resolution <8µm)

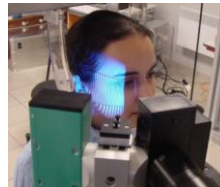


Fringes Projections – 3D



Skin surface

- ✓ Wrinkles (Face, lips)
- ✓ Micro relief
- ✓ Porosity
- ✓ Skin texture



Local & Global Shape (Body & face)

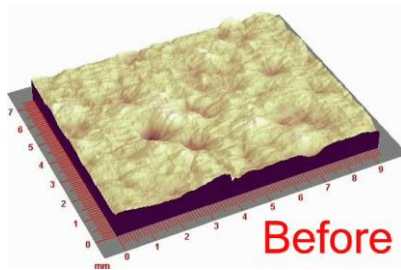
- ✓ Morphology of the face (ageing, skin and tissues sagging, ptosis...)
- ✓ Mobility & tissues firmness (DyanSkin)
- ✓ Body shapes (whole or parts)
- ✓ Eye bags
- ✓ Real volume of lips
- ✓ ...



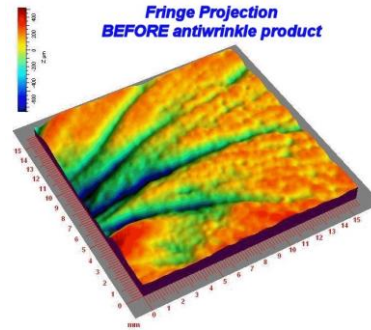


Fringes Projections – 3D

Standard applications
Wrinkles and Micro relief - Vivo / Vitro



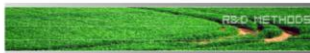
Before



Fringe Projection
BEFORE antiwrinkle product

QUANTIFICATIONS :

- Roughness, porosity, anisotropy of micro relief (resolution < 10µm)



Fringes Projections – 3D

Wrinkles – Advanced Analysis

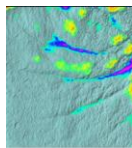


Fringe projections – Surface state – Object analysis and visibility

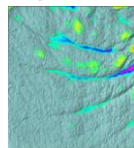
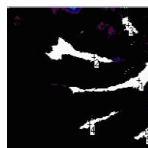
✓ Standard analysis: Roughness

✓ More recently :

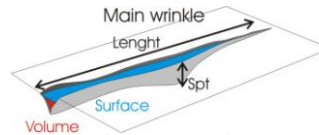
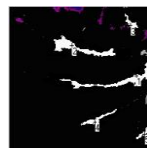
- « Object analysis » : surface, volume, number of wrinkles...
- Morphology of the wrinkles (Shapes, opening, slopes, curvatures...)
- Density of contrasts : Combination of 3D acquisitions and pseudo photographs = VISIBILITY of Wrinkles



Before



After treatment

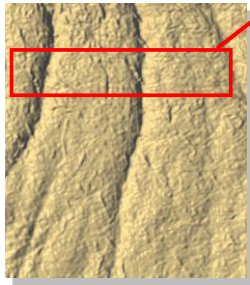




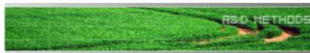
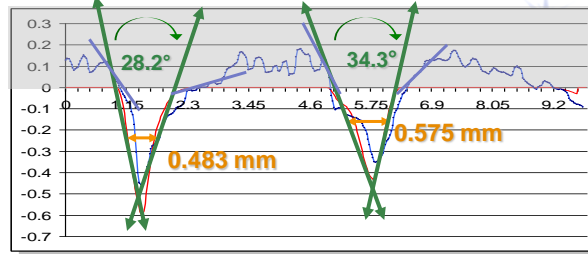
Fringes Projections – 3D

Morphology of Wrinkles – Advanced Analysis

Extraction of profiles
Calculation on the « average profile »



Calculation of the opening angle of each wrinkle
Calculation of the width of each wrinkle
Calculation of the slope (border of wrinkle)



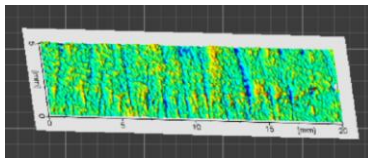
Fringes Projections – 3D

Real volume of lips – Advanced Analysis

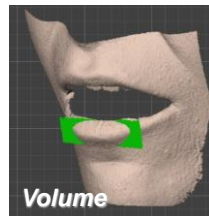


Fringe projection – Measurement of the real volume of lip (and roughness)

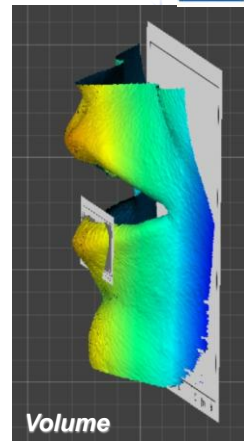
- ✓ Validated
- ✓ Roughness and volume



Roughness



Volume



Volume





Fringes Projections – 3D

Face – Advanced Analysis



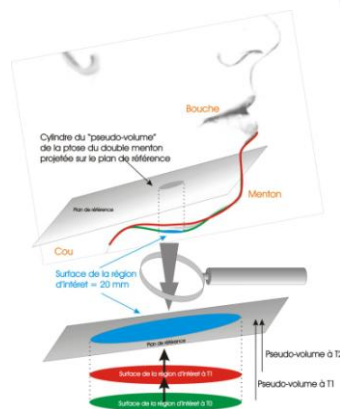
A new way to evaluate global and local modification of the face shape and the relation ship with the ageing (folds, sagging, slackening, ptosis)

Measurement in 3D and without any contact, of the skin and subcutaneous firmness and mobility



Fringes Projections – 3D

Face – Local and global modifications of the face morphology

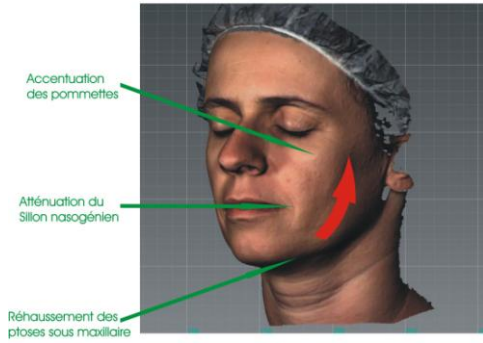




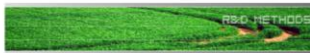
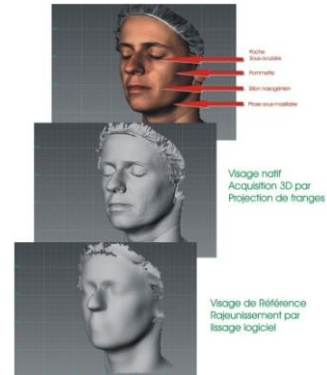
Fringes Projections – 3D

Face – Ageing – Self-reference

Effets global du traitement sur la morphologie du visage



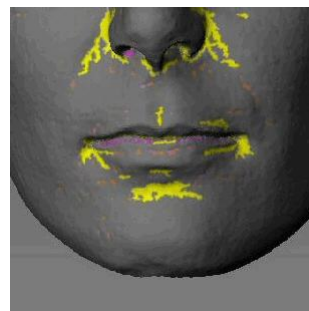
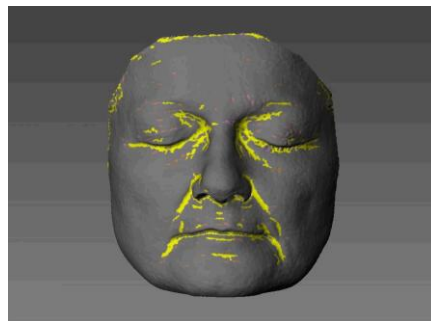
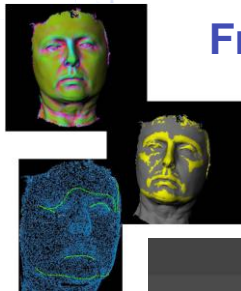
AUTO-REFERENCEMENT
Calcul des écarts de forme entre le visage natif de chaque sujet et son propre visage lissé (ou rajeuni logiquement)



Fringes Projections – 3D

Face – Ageing – Curvatures

- Analysis of curvatures for different scales : Wrinkles, folds and local areas
- Sagging and tissues slackening

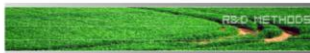
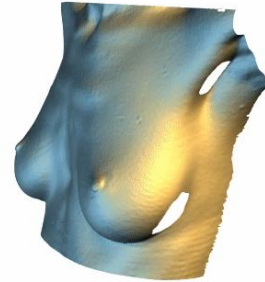
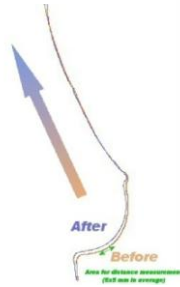
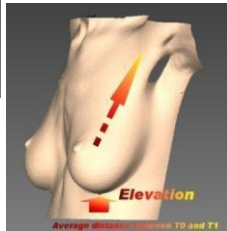
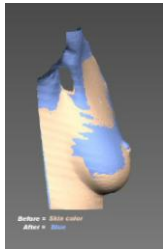




Fringes Projections – 3D

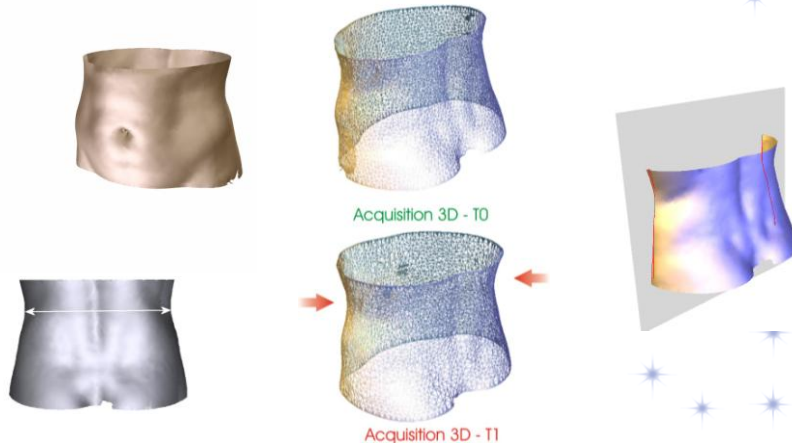
Body Morphology

Measurements of distances, surfaces, crossed sections and volume of different body parts



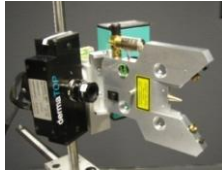
Fringes Projections – 3D

Body Morphology





Fringes Projections – 3D

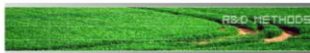


New technique for the measurement, in 3D and without any contact, of the skin and subcutaneous tissues mechanical properties (firmness, mobility – Face and Body)

DynaSkin®

« Intuitive measurement of the skin firmnes »

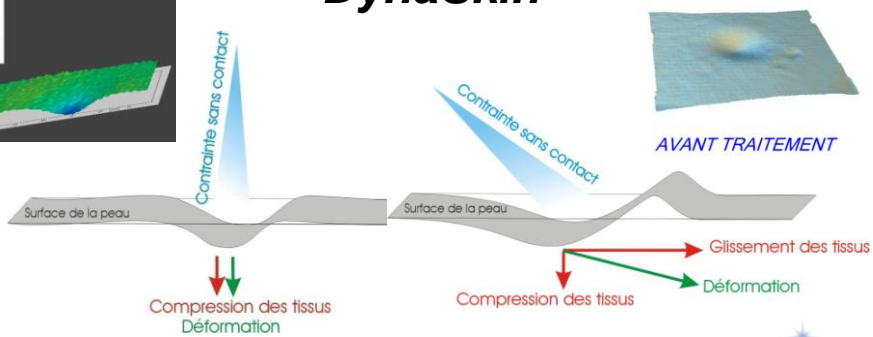
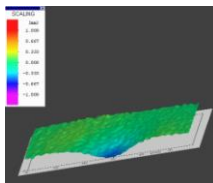
- ✓ Pressure induced onto the skin with a calibrated air flow
- ✓ Deformation, without contact, perpendicular to the skin or with an incident angle.
- ✓ Stable pressure
- ✓ Quantification : Three 3D acquisitions (fringe projections), before, during and just after the constraint application (air flow).
- ✓ High repetability and reproducibility (CV 0.8%) for accurate measurements.



Fringes Projections – 3D



DynaSkin®

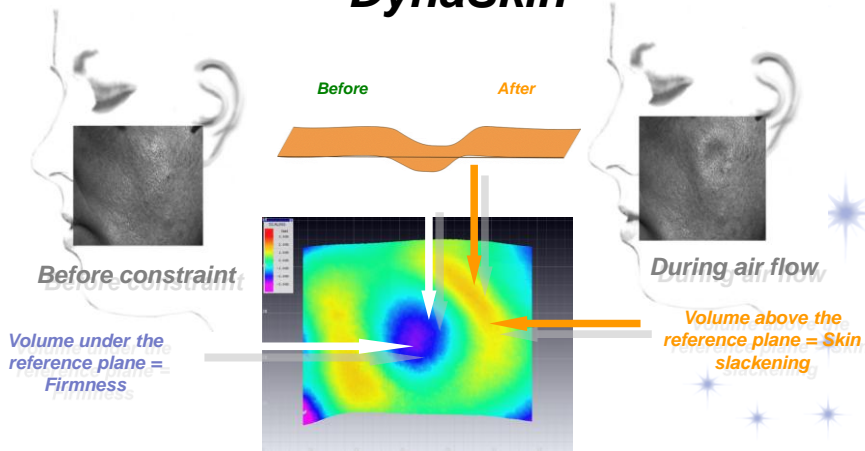


Perpendicular constraint : Evaluation of the tissues firmness and skin tension

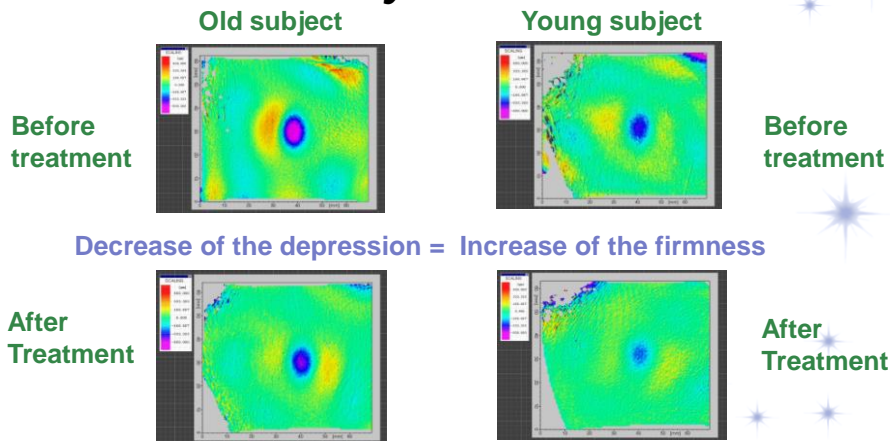
Incident angle : Firmness AND mobility of the different cutaneous layers



Fringes Projections – 3D DynaSkin®



Fringes Projections – 3D DynaSkin®





Technologies Coupling

Skin complexion and radiance - Multi-parametric analysis
« Information Matrix » - In progress

Face radiance, several parameters :

- 1) Characteristic color for specific areas (dark circle, cheekbone...) and distribution of these color - **Image analysis of photographs – FrameScan** (Orion Concept/Cosm'o Lab)
- 2) Modalities of the light reflexion onto the skin (Specular, Diffuse brightness, backscattering) - **Goniolux measurements** (Orion Concept/Cosm'o Lab)
- 3) Texture of the skin – Porosity, microrelief, wrinkles... - **Fringe projection measurements** (Eotech)
- 4) Clinical evaluation based on colorimetric scales – “Skin Color Charts” (Orion Concept/Cosm'o Lab)



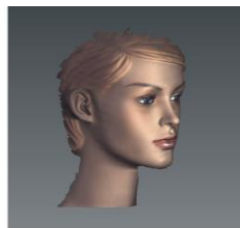
Data Matrix – Mathematical extraction of the “Information”
Comparison to references : « Well Complexion Matrix» and « Bad or Tern Complexion Matrix»



Technologies Coupling

Photographs and 3D acquisitions
Visualisation of quantified parameters by images analysis on a 3D model
« Skin radiance »

Visualisation of the quantified variation of color for different parts of the face



BAD Skin Radiance

GOOD Skin Radiance

QUANTIFICATIONS :

- Identification of colors for different area of the face : “Reconstructed Colorimetric Cartography”
- Mapping on a 3D model in a controlled virtual scene for visualization and/or clinical evaluation

(Visualisation of the colorimetric parameters from the ‘Information Matrix’)





Technologies Coupling

Photographs and 3D acquisitions

Visualisation of quantified contrasts by images analysis on a 3D model
« Aged and Marked Face » - « Morphological ageing »

Visualisation of the contrast variations related to the relief and shape of the face (folds, sagging, slackening...)



YOUNG FACE
Smoothed shapes
Low contrasts



OLD FACE
Broken curves
High contrasts

QUANTIFICATIONS :

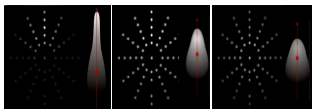
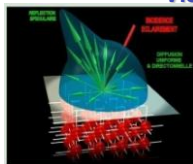
- Identification of local contrast of the face : "Reconstructed Contrast Cartography"
- Mapping on a 3D model in a controlled virtual scene for visualization and/or clinical evaluation (Visualisation of the colorimetric parameters from the 'Information Matrix')



LVMH RECHERCHE
PARFUMS & COSMETIQUES

Technologies Coupling

Goniolux4D® (Orion Concept/Cosm'o Lab) and 3D acquisitions
Visualisation of the reflected light modalities by the skin



Glossy



Satin



Mat

Product effect

QUANTIFICATIONS :

- Specular reflection (brightness), Backscattering, Anisotropy of reflection, Total reflection
- Mapping on a 3D model in a controlled virtual scene for visualization and/or clinical evaluation (Visualisation of the colorimetric parameters from the 'Information Matrix')



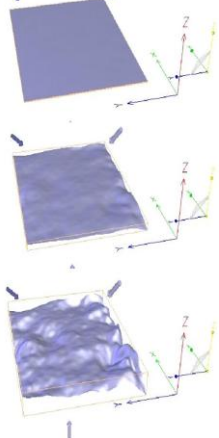



Technologies Coupling

Pseudo-photographs and 3D acquisitions



Realistic photographs based on 3D acquisitions to define calibrated and linear scales for clinical evaluation (Cellulite, wrinkles, skin texture...)



- Realistic snapshots obtained from the fringe projection acquisition
 - Definition of the color (skin) & and of the optical properties of the surface (Lighting, brightness...)
 - Stability of the lighting incidence (revealing the relief)
 - Only one variable parameter = **The RELIEF...**
- 
- Realization of a visual, calibrated and quantified clinical scale
 - Continuous and linear values of grades
 - Real values of roughness for each grades
 - External reference for **Clinical evaluation comparisonsque Comparative**

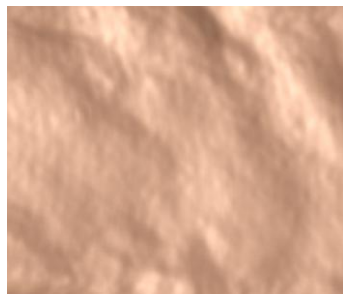


Technologies Coupling

Pseudo-photographs and 3D acquisitions



Definition of different categories of relief morphologies (cellulite, wrinkles...)



Lateral side of thighs



Posterior side of thighs



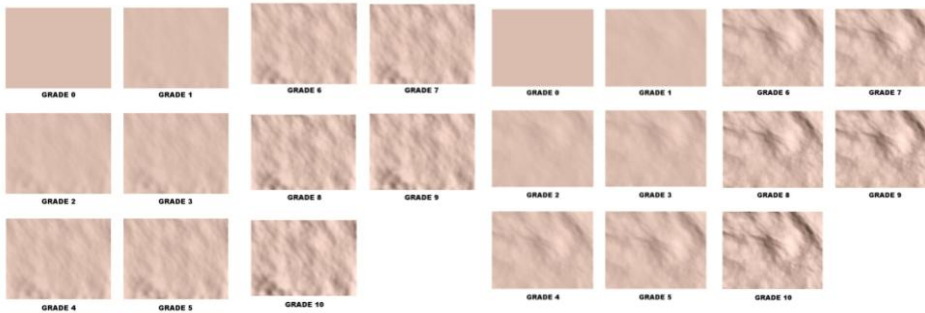


Technologies Coupling

Pseudo-photographs and 3D acquisitions



Definition of scales for each categories



Category 1: Regular aggregates

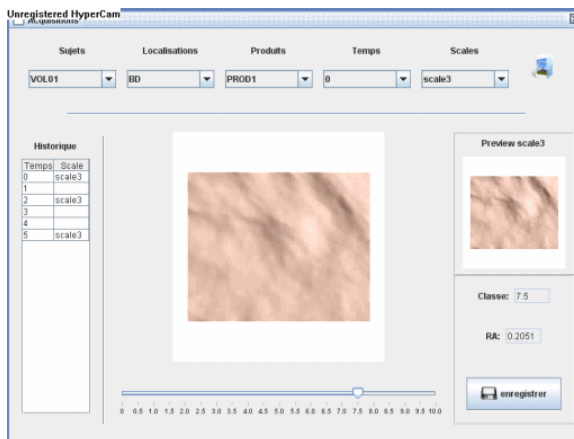
Aspect 3: Irregular aggregates



Technologies Coupling

Software for the clinical evaluation based on these scales

Calculation of the real roughness for each grades



Same approaches for the colorimetric evaluation by clinician
(Skin radiance, make-up, pigmentation...etc)
In progress





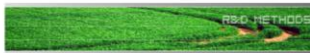
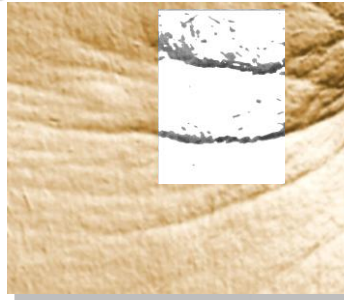
Technologies Coupling

Pseudo-photographs and 3D acquisitions
Visibility of Wrinkles – Advanced Analysis

Measurement of the visibility of wrinkles based on 3D acquisitions and photographs analysis

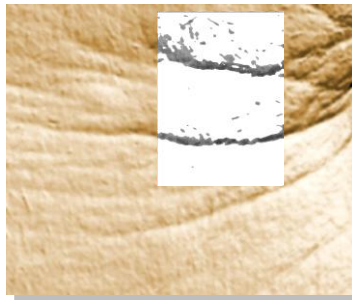
- ✓ Acquisition of a 3D surface
- ✓ 2D Snapshot 2D in a controlled & reproducible virtual scene (Controlled lights, color, incidence, intensity)
- ✓ Image analysis (FrameScan, Orion-Concept, France)

- Binarisation Mask (Baseline)
- Analysis of the shadow density into the wrinkles
- Correlation with the clinical evaluation

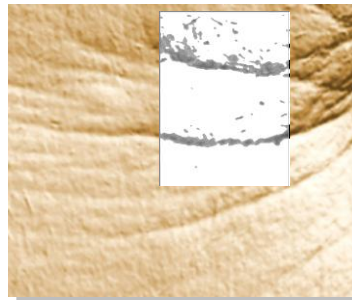


Fringes Projections – 3D

Visibility of Wrinkles – Advanced Analysis



Before



After treatment

NdG : -5.1%
Density : -10.5%





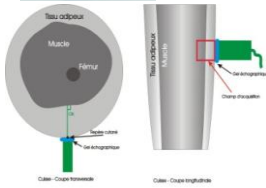
Echography - Low & High Frequency

2D et 3D Quantifications



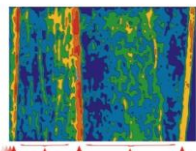
Mindray 3300

EchoScan® V02 Adipose tissue



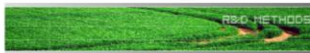
QUANTIFICATIONS :

- Thickness
- "Fat density of the tissue"
- Fibrous structure
- 3D reconstruction (In progress)



Labels: Fat, Muscle, Aponeurosis, Tissue, Hypodermis, Dermis (Superficial)

Verified correlation of the « fat density » and Age/BMI



Echography Low & High Frequency

2D et 3D Quantifications



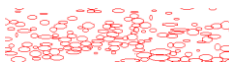
EchoScan® V02 Dermis - Hypodermis



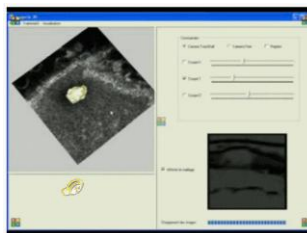
Acquired



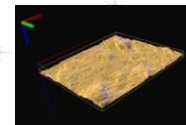
Segmented image



Diffuser detection



- THICKNESS of dermis (Active contours)
- SENEb : Differential echogenicity (deep and superficial)
Verified correlation with the ageing
- TEXTURE : Nb of diffusers (collagen density), size, density of dermis, homogeneity and entropy
- Calculation of the "Cutaneous Age" (Database)
- 3D reconstructions: 3D texture, Volume of the "High density" and "Low density" dermis, dermis/hypodermis surface, calculation of roughness and volume of fat tissue penetrations (cellulite)





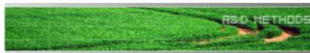
In Vivo Confocal Microscopy

ConfoScan® V01

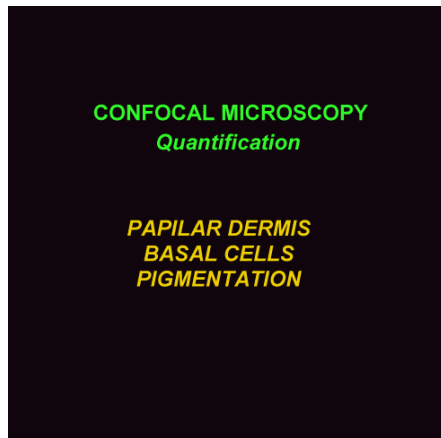
Microscopic imaging in live of the skin (from 1µm to 5µm)
Different levels of information :



- ✓ Cellular
 - Melanocytes, keratinocytes, basal cells (cellular morphologies, density, size, number ... (Model analysis)
- ✓ Tissular
 - JED, Papilla (Height, shape, number...)
 - Collagen and elastin network (Reticular dermis, structure, density)
- ✓ Dimensional measurements
 - Thickness of Stratum Corneum, epidermis...(reconstructed slices X, Y, Z)



In Vivo Confocal Microscopy



- Vieillesissement
- Pigmentation
- Stratum Corneum
- Granular layer
- Spinous layer
- Basal layer
- Upper Papillary dermis
- Mid Papillary dermis
- Lower Papillary dermis
- Superficial reticular dermis





In Vivo Confocal Microscopy

Repetability of analysis = ConfoScan® V01

Requirements for a good image analysis :

- ✓ **A good location of the depth**
 - To measure at the same depth at the different time of kinetic
- ✓ **Correction of the signal attenuation**
 - By the laser power value
 - By an internal reference
- ✓ **Quantification on a representative area**
 - ✓ Stacks or Mosaics (repetition of an elementary acquisition)
 - ✓ Definition of specific acquisition protocols
- ✓ **Management of the sample (panel):**
 - The control of analysis parameters for a subject and their application at different times of measurements



In Vivo Confocal Microscopy

Repetability of analysis = ConfoScan® V01

First analysis: Ageing and Pigmentation

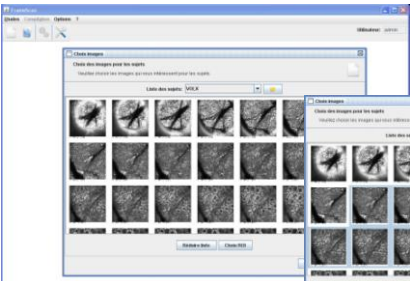
- ✓ **Pigmentation : Basal cells and melanocytes**
 - Number, density (melanin contain) and distribution into the skin
- ✓ **Ageing : thickness of the SC, Papilla shapes, Réticular dermis**
 - Thickness measurements on reconstructed Z slices:
 - Thickness of SC and epidermis
 - Height and width of papilla
 - Measurements in the acquisition plane :
 - Papilla (morphology, density, size, number...)
 - Collagen and elastin network (texture analysis)





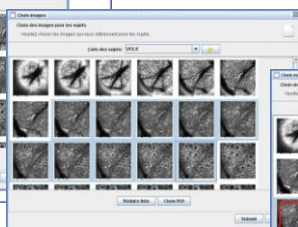
In Vivo Confocal Microscopy ConfoScan® V01

- **Software – Management of the sample (N subject P times)**
- **Definition of an analysis process**

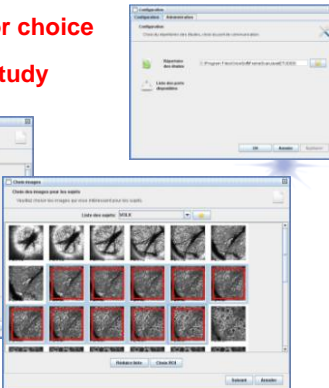


**Loading of
Stacks for one subject
at the different times**

**Creation or choice
of a study**



Selection of slices



Selection of ROIs



In Vivo Confocal Microscopy ConfoScan® V01



- ★ **One process for each quantification :**
 - ✓ **Pigmentation : Papillar dermis**
 - ✓ **Ageing: Papillar dermis, Reticular dermis**
 - ✓ **Z Reconstructions for thickness measurements**
- ★ **Compilation of results for the whole sample**
 - ✓ **Excel, Text and PDF files**



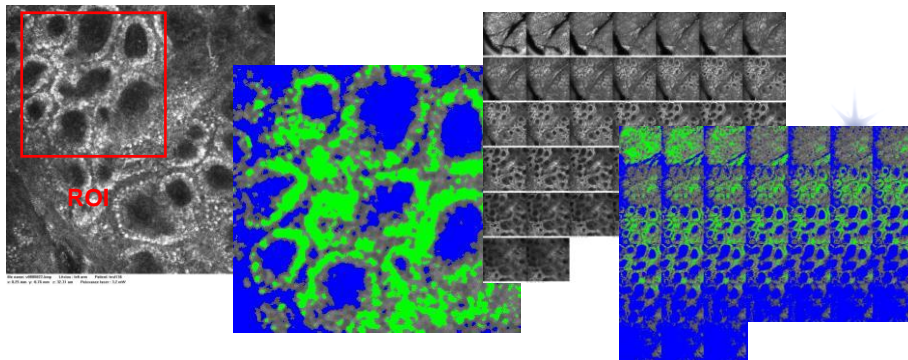


In Vivo Confocal Microscopy

ConfoScan® V01

Pigmentation analysis

✓ Number and melanin contents of basal cells and melanocytes

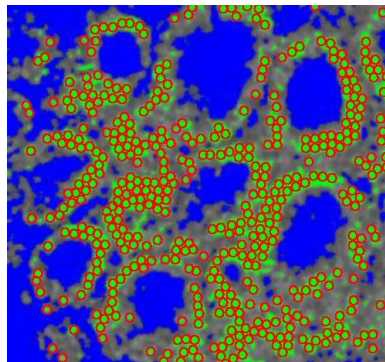


In Vivo Confocal Microscopy

ConfoScan® V01

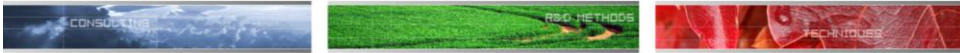
Pigmentation analysis by « model »

✓ Number and melanin contents of basal cells and melanocytes



Cell model – detection
and quantification





In Vivo Confocal Microscopy

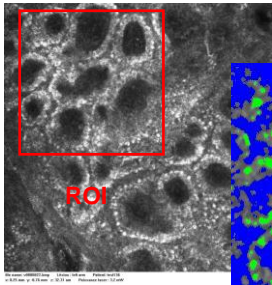
ConfoScan® V01

Ageing analysis - Papilla

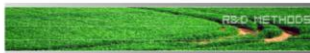
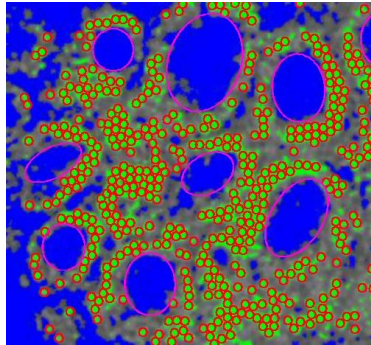
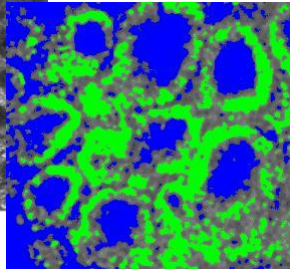
✓ Number, density, orientation and shape criteria of papilla

Cell model – detection

and quantification



ROI



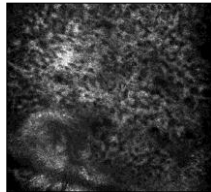
In Vivo Confocal Microscopy

ConfoScan® V01

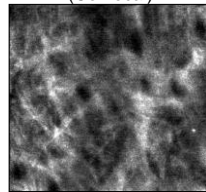
Ageing analysis – Superficial reticular dermis

✓ Texture and density : different appearances

Photodamaged Elastin
(Confocal)

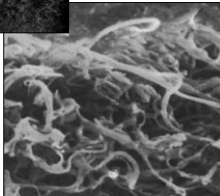


Normal Skin
(Confocal)

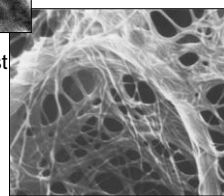


Example :
Elastosis
Photo-Ageing

75 year old panelist
In-vivo confocal



41 year old panelist
In-vivo confocal



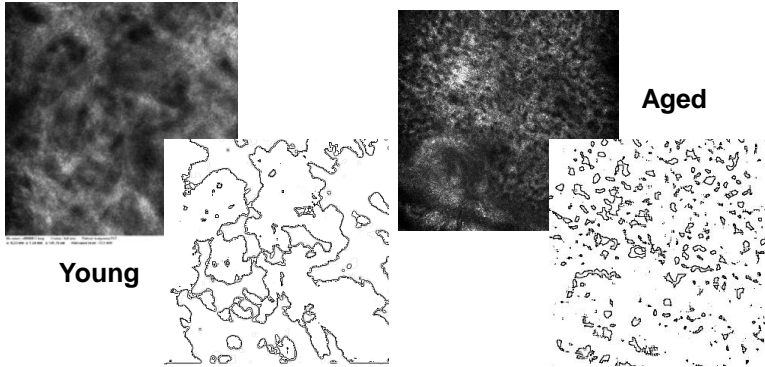


In Vivo Confocal Microscopy

ConfoScan® V01

Ageing analysis - Superficial reticular dermis

✓ *Texture and density : Different organisation and size of fibers*



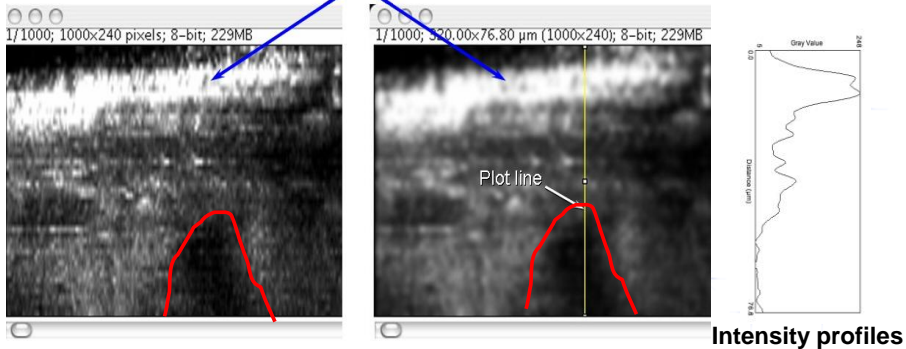
In Vivo Confocal Microscopy

ConfoScan® V01

Ageing analysis – Height of papilla and SC...

✓ *Z reconstructions*

✓ *Measurements : Height, width, intensity profiles of SC...*



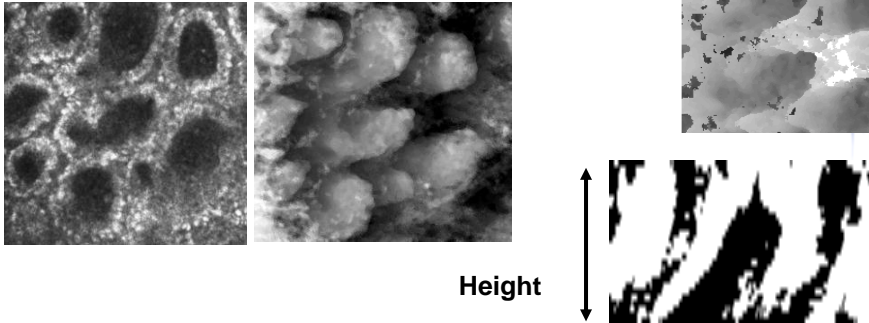


In Vivo Confocal Microscopy

ConfoScan® V01

Ageing analysis – Dimensional measurements of papilla

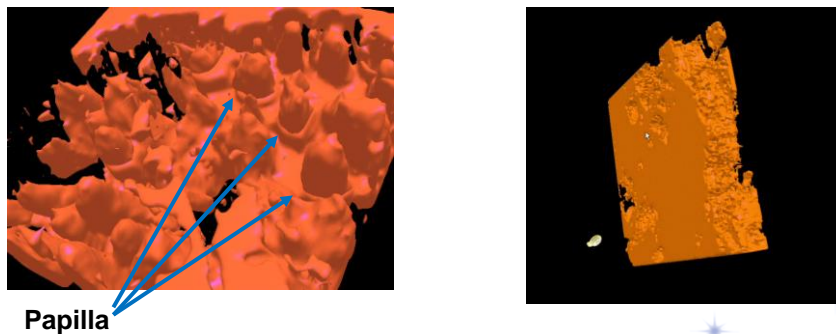
- ✓ X, Y, Z reconstructions
- ✓ Measurements : volume and orientations



In Vivo Confocal Microscopy

ConfoScan® V01

...Surfacic 3D reconstructions
and new quantifications ... in progress ...



For tomorrow... and the next edition of the « DIIP meeting » !!

Thank you for your attention

