G.Y.N.A.S.

Gynecology Analysis System

Image Processing Applications for the Detection of Micro-Calcium Deposits in Very Early Forms of Breast Cancer with an Artificial Intelligence Approach

CONTENTS

EXPERTISE

- **Instrumentation and image processing in astronomy and space applications**
- **Document handling for very large volumes of computer data, text, or images**
- **Intelligent retrieval system**
- **Data compression on computers, networks and telecommunication**
- **Data security in telecommunication and networks, including satellites**
- **Quality control systems for the manufacturing industry**
- **Hardware and Software developments.**

GYNAS
Gynecology Analysis System

Computer workstation concept with:

Image and textual database

LAN (Local Area Network) with distributed intelligence

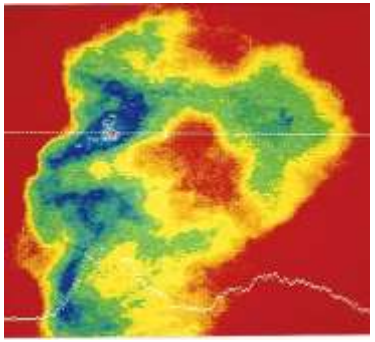
- **database server**
- **analysis station**
- **general work station**
- **scanning station**
- **output devices (printers, etc.)**

System contains :

- **database of textual description**
- **image database for raw and processed images**
- **tools for the doctor to analyze the images.**

Statements

- Breast cancer is advancing at an alarming rate
- Detection of very early forms of breast cancer (micro-calcification based) can help doctors in diagnosis
- Digital image processing can assist the detection of very early forms of breast cancer.



Methods

- Mammography X-ray films are scanned or digital radiography (preferred) is input for the analysis
- Special computer image processing techniques are applied.

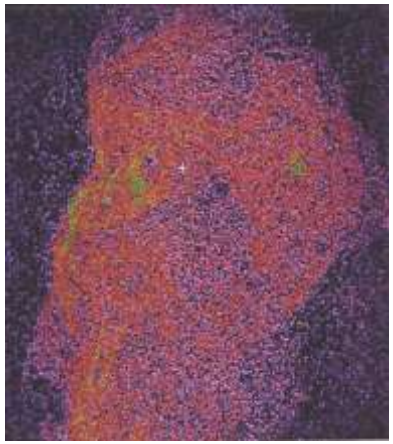
Results

1. Digital image processing techniques can detect much smaller micro-calcium deposits than the human eye can see

2. Interpretation with an artificial intelligence /neural network based system is suggested

3. Presentation of the results in degrees of probability for malignancy

4. Interpret new finds from digital analysis (like cocoon structure).



Outlook

- Arrive at an automated system for pre-selection of images.

Why Automated Digital Imaging ?

Human factor:

The doctor has not spotted the micro-calcium deposits in a mammography; patient comes back one year later and a lump has evolved.

Re-inspection of the previous X-rays does show very small micro-calcium deposits.

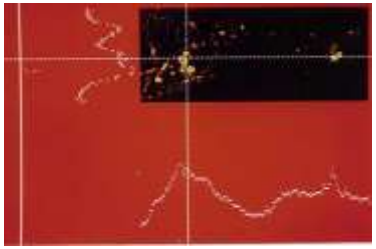
→ They have been simply overlooked due to various reasons because of their small size.

Computer modelling for micro-calcifications:

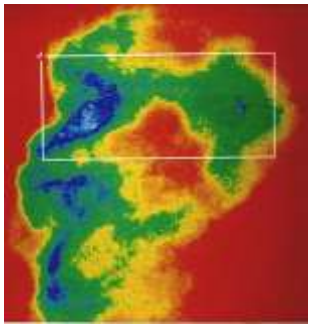
- **assists diagnosis with assured background information**
- **detects micro-calcifications smaller than the human eye can see**
- **speeds up recognition process.**

Analysis Approach

Feature extraction:



- 2- and 3-dimensional area of interest (AOI) representation
- special filtering algorithms after contrast stretching
- associative and logical assertions (model building).



GYNAS Phase I :

1. analysis of known micro-calcifications
2. reference library setup
3. model extraction.

-→ Test models and the knowledge acquired.

GYNAS - Phase II

When *"hit rate"* with models is satisfactory, transfer into logical abstraction :

1. **add artificial intelligence procedures (rules)**
2. **system rule structure changes with experience**
3. **apply "fuzzy-logic" concept**
4. **present probabilities for a hit rate**
5. **implement neural network self-learning features.**

User involvement :

Interactive learning process of the system with user interaction is mandatory during the first phases.

Aim :

Automatic pre-processing of the information in order to arrive at only critical decision points for the doctor to intervene.

Presentation of Results

- System informs of probability for breast cancer based on micro-calcifications
- Attention is drawn to specific image details for further analysis.

Human interaction :

- revert to visual inspection on the computer screen
- use image processing algorithms presented in a format the doctor can use without special image processing knowledge.

Financial Requirements

Project Cost approximately CHF 7’500’000

Project Realization

Personnel:

- Project Manager
- Chief Medical Advisor
- Chief Image Analyst
- Image Processing Analyst
- Computer Software Specialist (2)
- Computer Analyst (2)
- Coordinator / Administrator

Time Schedule

GYNAS Phase I and II - 12 months