

Sensigent eNose[®] Sensors



- ▶ Technology
 - Nanocomposite Sensors
- ▶ Products
 - Cyranose[®]
 - eNose[®] Aqua

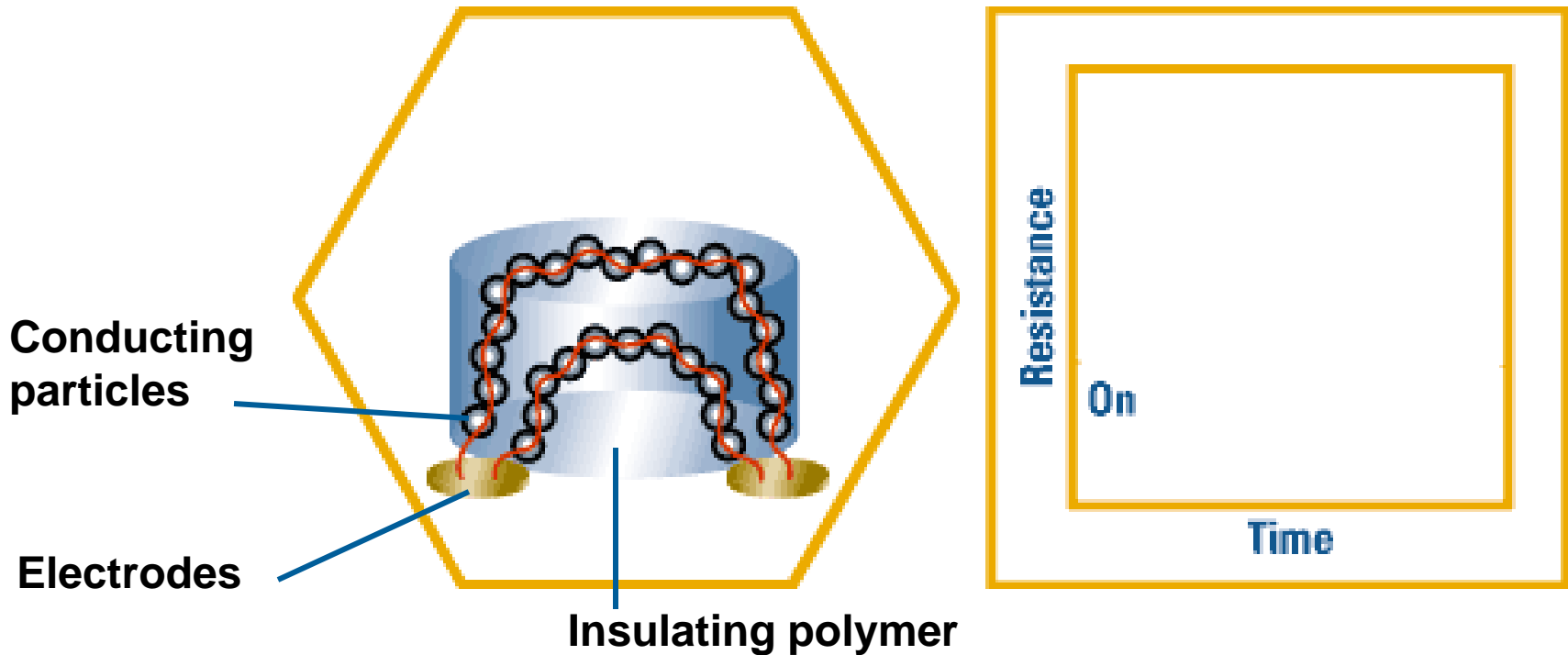


Sensors

- Metal Oxide Semiconductors
- Electrochemical
- Mass sensitive Devices
- Bulk Conducting Polymers
- Polymer Solvatochromic Dyes
- Polymer Composite Sensors
- Carbon Semiconductors

Sensor Technology

Nanocomposite Array (NCA) Sensors

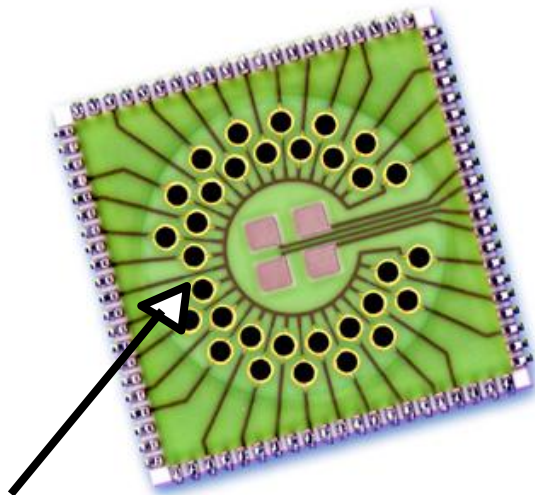


The vapor passes over the organic matrix and the swelling produces a change in resistance

A relative resistance measurement is made for each of the 32 sensors

Nanocomposite Sensor Array

Composite sensor = polymer + conducting nanoparticles



conductive
polymer
composite

Sample polymers:

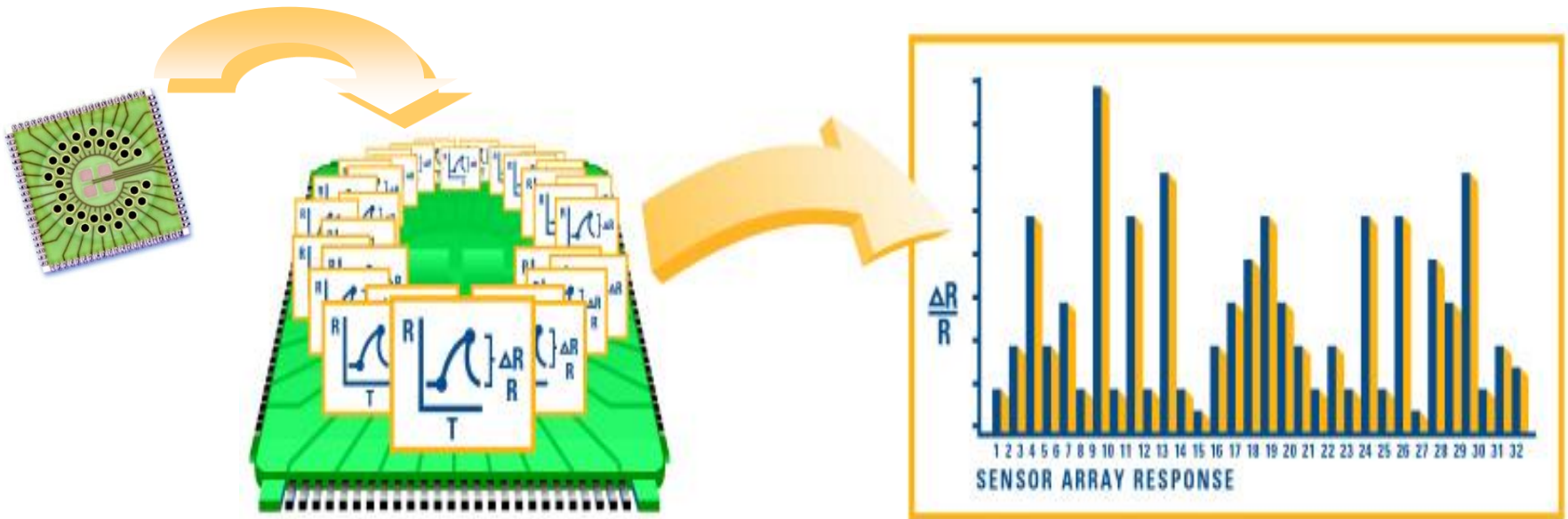
- poly(vinyl butyral)
- poly(vinyl acetate)
- poly(styrene)
- poly(ethylene oxide)

Conducting nanoparticles:

- carbon black
- carbon nanotubes

Sensor Technology

Array Based Chemical Sensing



Using proprietary pattern matching algorithms, the data is converted into a unique response pattern

Sensor Materials

Conductors

Carbon black
Carbon nanotubes
Metal nanoparticles
Intrinsically conducting
polymers
Semiconductors

Non-Conductors

Oligomers/Polymers
Organic molecules
Enzymes
Antibodies

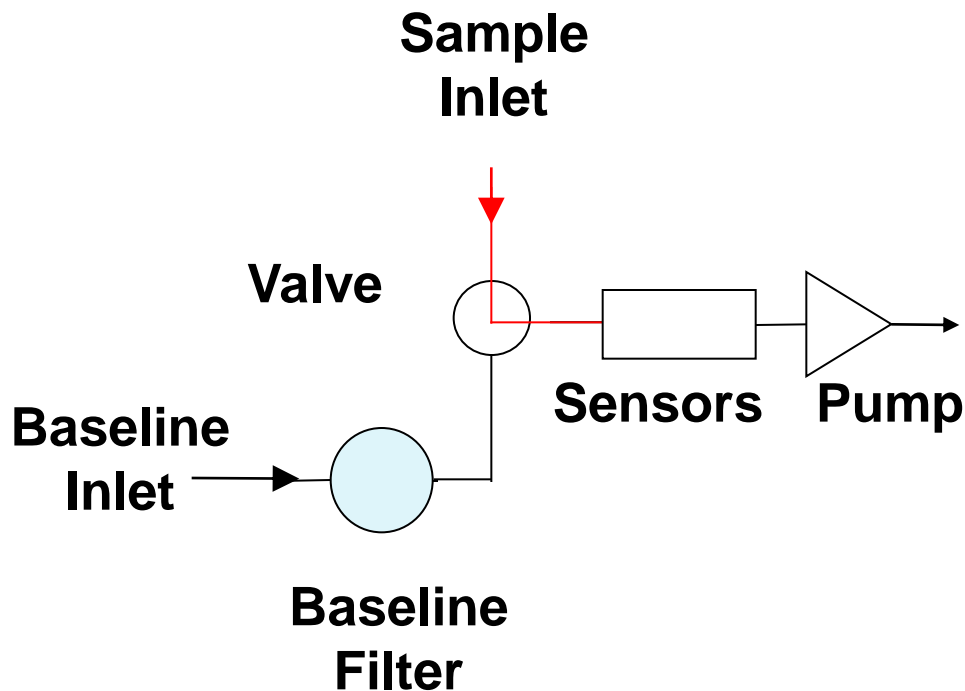
A vast range of sensor compositions are possible.

Sensor Characteristics

- ▶ Inexpensive
- ▶ Portable
- ▶ Easy to operate
- ▶ Reproducible signal
- ▶ Robust in various environments
 - Background interference accommodated
 - Temperature compensated sensor array

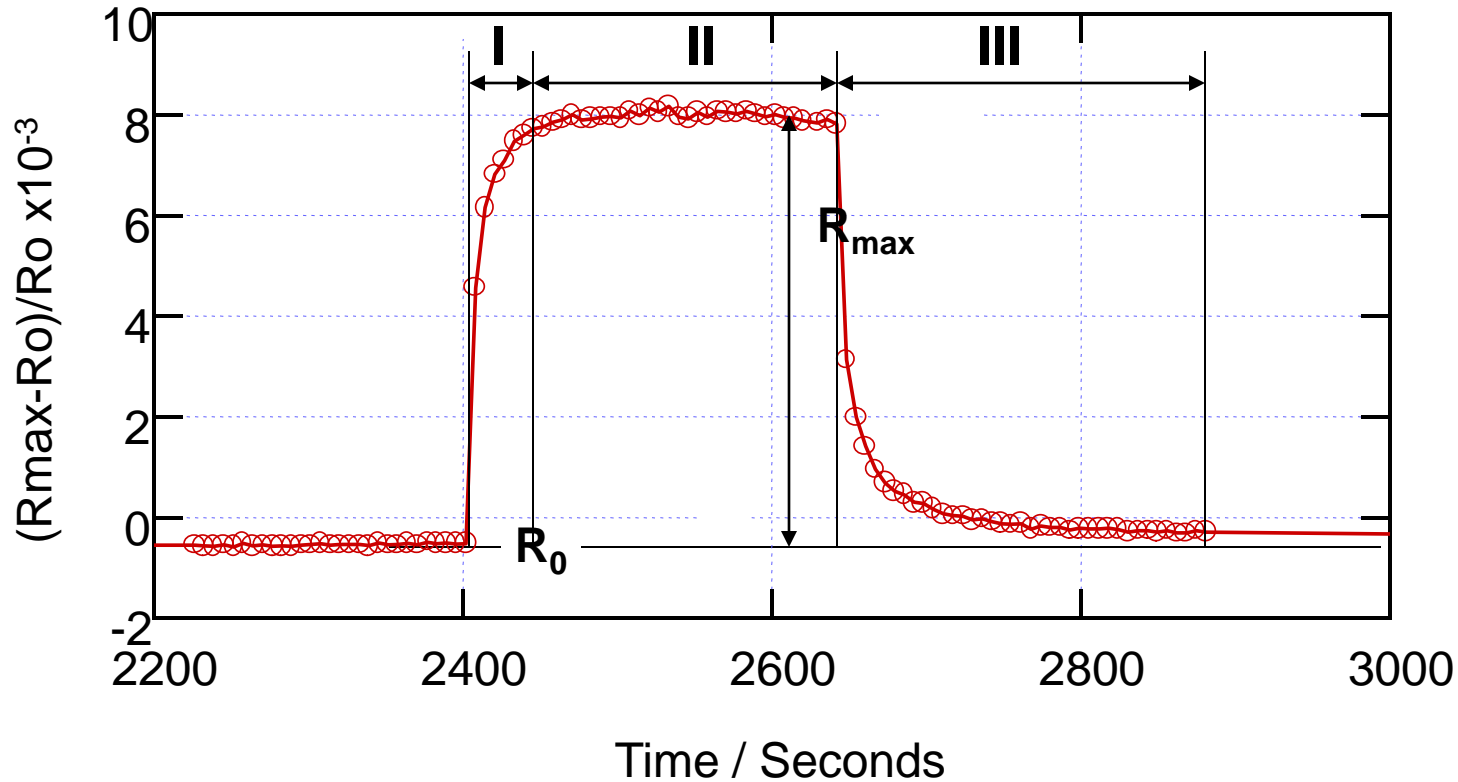


Simple Air Sampling System



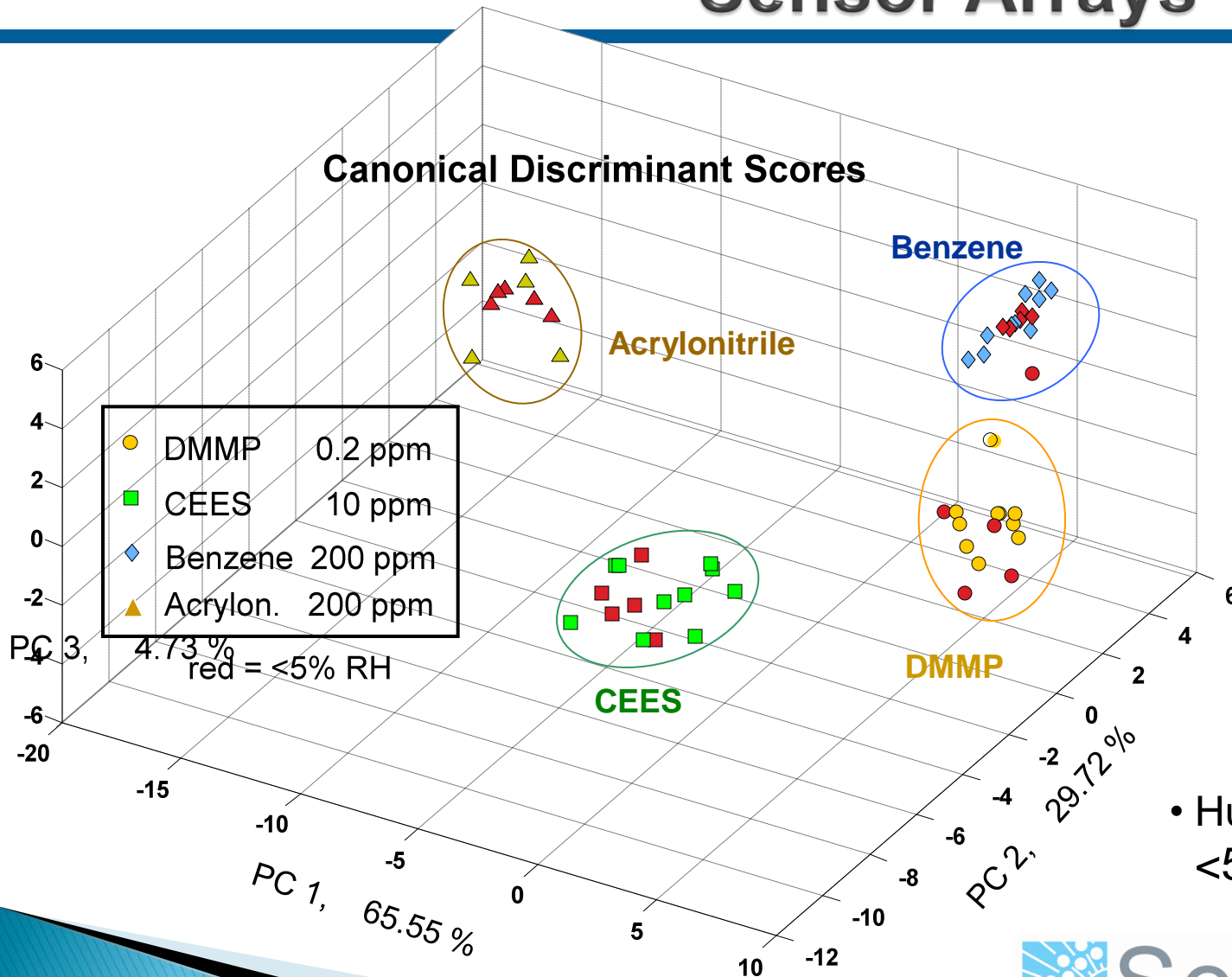
- ▶ Valve switches to introduce sample
- ▶ Always take a relative measurement

Calculation of Sensor Response



I = dynamic region II = steady-state region III = recovery region

Chemical Identification with Sensor Arrays



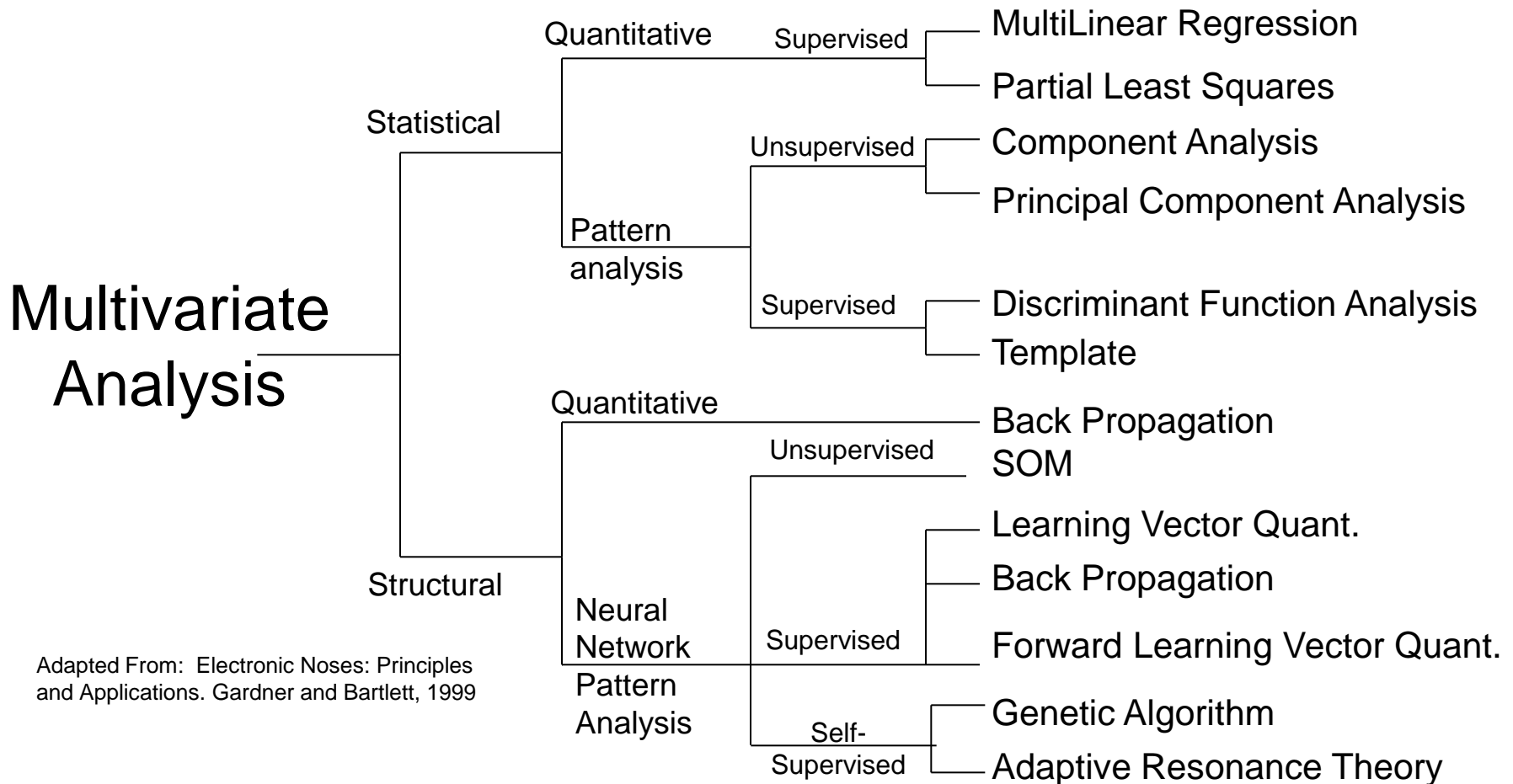
- Sensor response pattern is robust with matrix variation

- Humidity levels: <5, 60, 72% RH

Chemical Detection - *Summary*

- ▶ Sensitive
 - Detection at or below IDLH for many compounds
 - Linear response over wide ranges
- ▶ Reversible and Repeatable
 - Response in seconds
- ▶ Identification
 - Unique response patterns
 - Discrimination from interferents

Multivariate Techniques



Adapted From: Electronic Noses: Principles and Applications. Gardner and Bartlett, 1999

Cyranose[®] 320



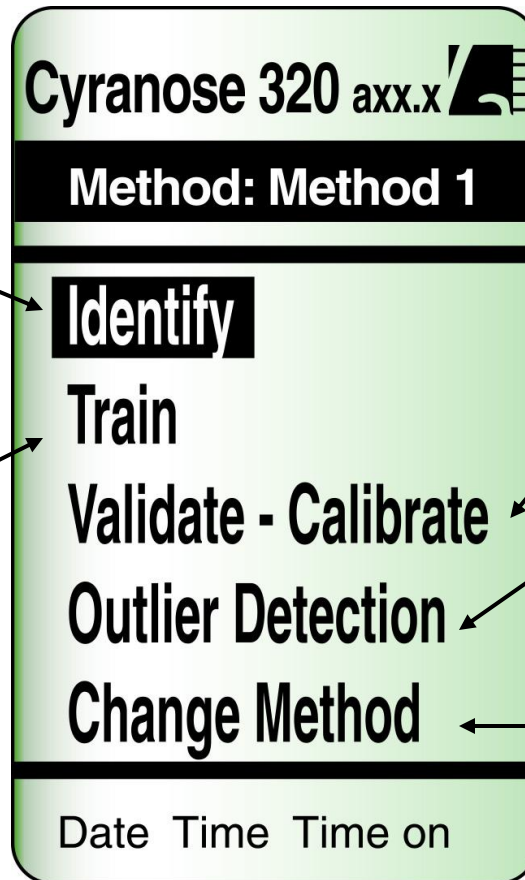
➤ **The C320 is the most widely used handheld eNose device ever produced.**

➤ **It has been in production for over 10 years.**

Cyranose[®] 320 Interface

Identify mode is used to identify a new sample

Train mode is used to teach the Cyranose 320 your class patterns

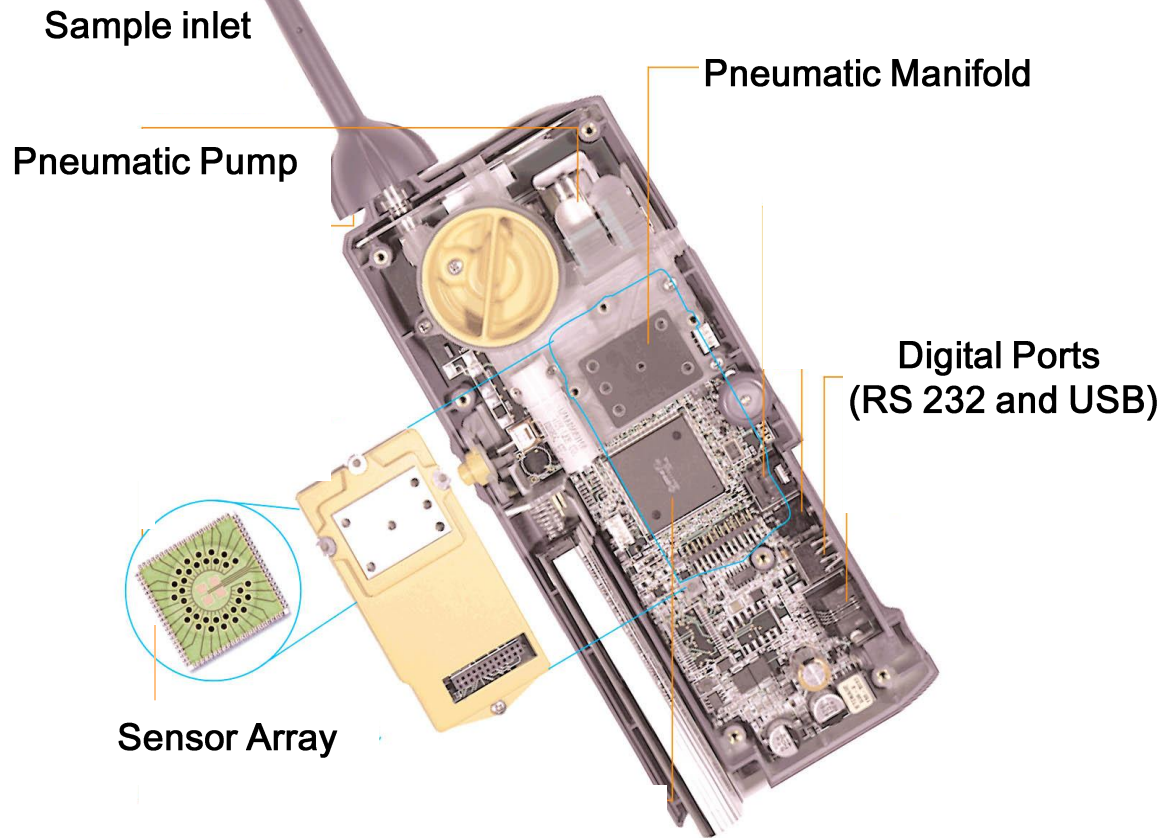


Build the statistical model of your training set data and check your training set data

Calculation of outliers

Select the active method

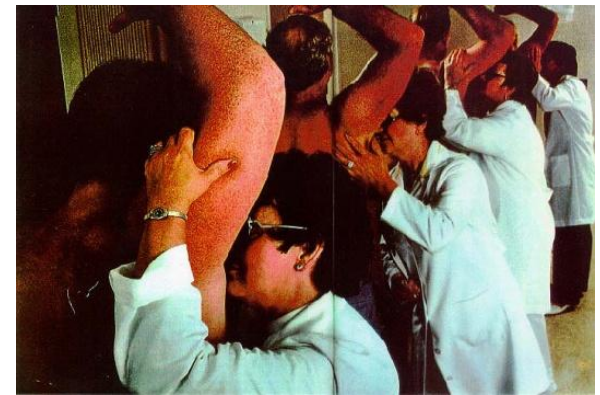
Inside the Cyranose[®] 320



Unique Use Models of the Handheld Portable eNose®

Taking the measurement out of the lab

- ▶ Quality Control
 - Widespread sampling for first screen
 - Confirm product identification or contamination
- ▶ Process Monitor
 - Process-line measurements
- ▶ Sensory Panels
 - Can replace some rote sensory panels



The Right Problem to Solve – Widespread Sampling as a First Screen

Solvent Verification

Chemical/Petrochemical Industry

Issue: An error in identification of the contents can have grave consequences if handled improperly

Scenario: The tank truck arrives and presents the shipping documents that list the contents of the tanker

Handheld eNose Use Model: The handheld eNose[®] is used to take a headspace measurement at the tanker's sampling port to verify the contents.



The Right Problem to Solve – Leak Detection and Identification

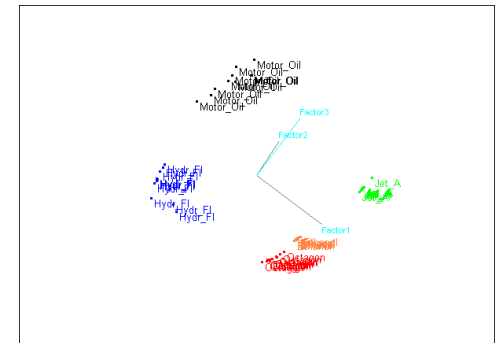
Discrimination of Common Aircraft Fluids

Aviation Industry

Issue: A fluid leak is spotted on or around an aircraft, causing flight delays while the identification of the fluid is sought.

Scenario: It is difficult and time consuming to bring analysis equipment to the leak due to the confined space on an aircraft

Handheld eNose Use Model: The handheld eNose[®] can be brought onboard or around the aircraft to the site of the leak to identify the fluid leak. Rapid identification of the fluid speeds maintenance.



The Right Problem to Solve – Process Monitor on a Production Line

Identification of Off-Odors in Fresh Fish Seafood Industry

Issue: An individual fish may release odors if filleted improperly, which releases stomach or spleen contents and contaminates an entire lot of filets

Scenario: Humans are stationed on the production line to smell each tray of fish as it moves through the production line

Handheld eNose Use Model: A handheld eNose[®] can be used manually for spot tests, or attached to the production line for continuous and 100% sampling



A Challenging Problem – Replacing Expert Sensory Panels

Evaluation of Citrus Oil

Beverage Industry

Issue: Annual crops grown in different regions have a major impact on the variation in flavor and aroma profile of a citrus beverage

Scenario: Expert sensory panels are required to judge these crop variations and decide on acceptability for use

The Challenge: The eNose® may be trained to a variety of crop changes, but may not replace a human sensory panel in this application due to the wide natural variation that exists



A Challenging Problem – An Infrequent Measurement

QC of a Natural Flavor

Flavor And Fragrance Industry

Issue: A flavor company uses sensory techniques to verify the quality of each batch of flavor that is manufactured as compared to a reference sample. The natural aging of the reference sample leads to a difficult assessment of product quality

Scenario: A comparison of digital “smellprints” of the reference sample would eliminate the effect of aging of natural ingredients, and provide the ability to compare “apples to apples”

The Challenge: The eNose® may be trained to store “smellprints” of reference samples for a few flavors or fragrances, but may not account for all of the formulations used in production



Finding the Right Problem to Solve

A measurement that is ...

- ▶ Taken day-in and day-out
- ▶ Is critical to
 - Product quality
 - Worker safety
 - Has financial consequence
- ▶ To which the sensors are appropriately sensitive

For product information or to place an order, please contact:

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