# Level of Information Noise and Prespectives of Odour Assessing GC-NN System


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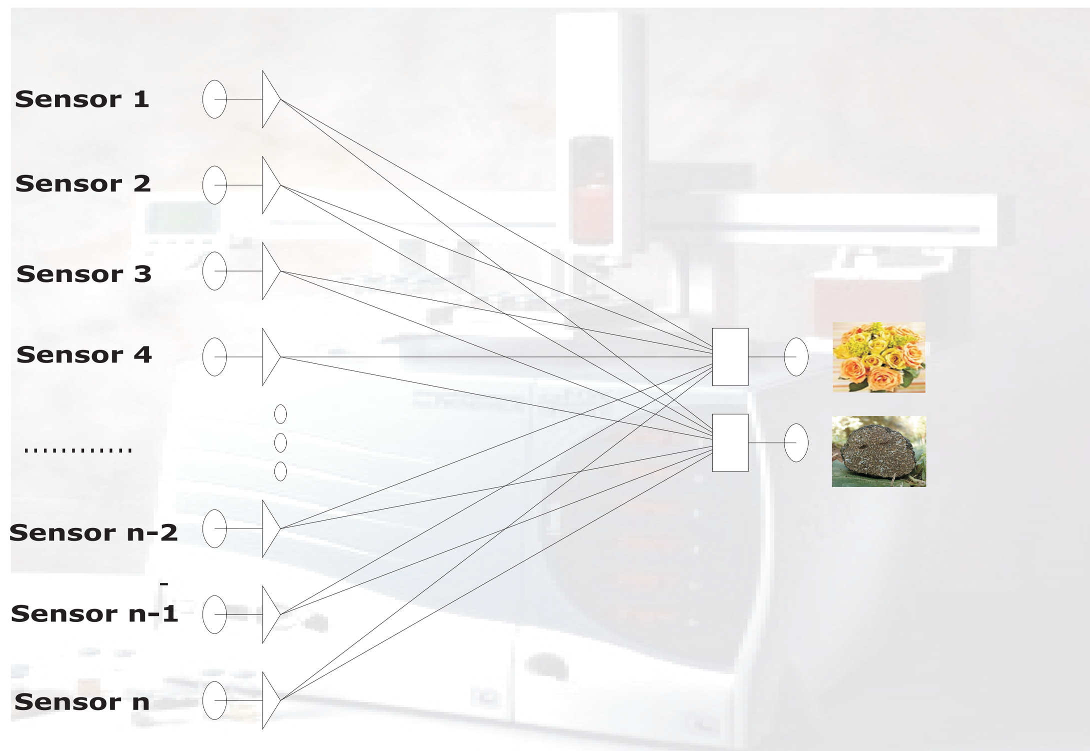
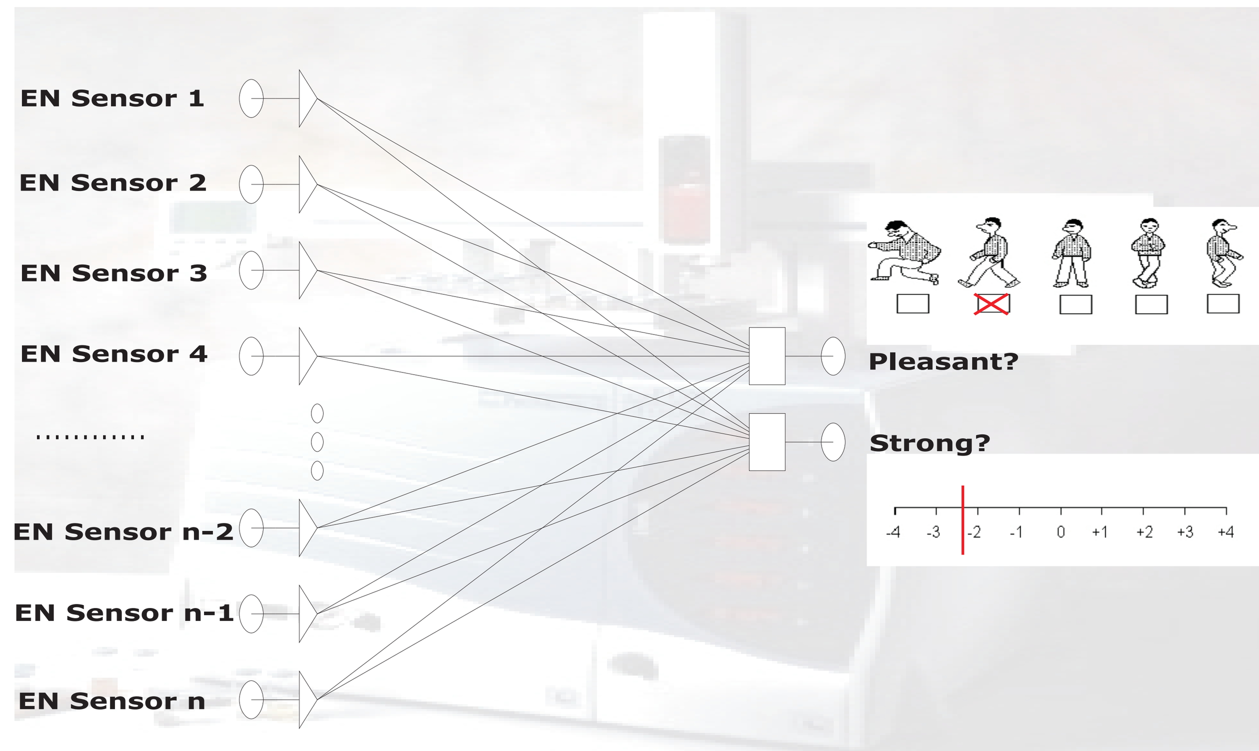
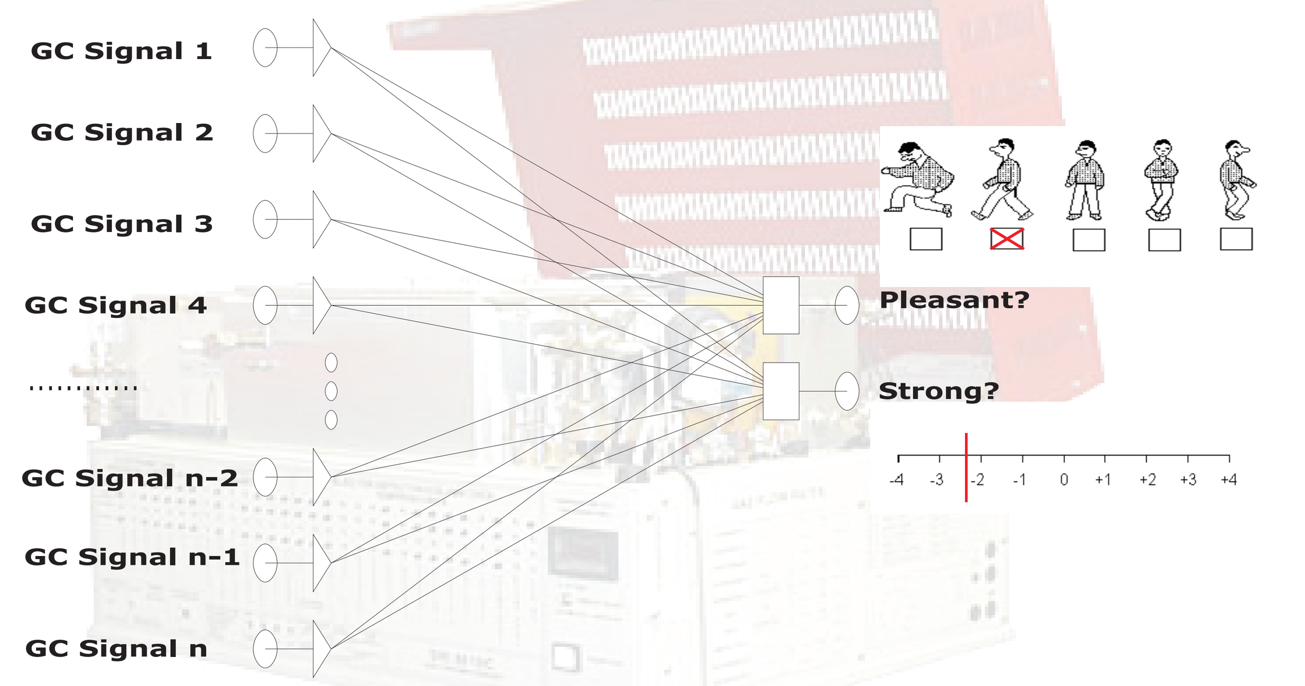
## INTRODUCTION




Odour kinds and brands of various food products (eg. coffee, alcohol, trufles) are determined with instruments called electronic noses. Trials to specify possibilieties of these instruments to determine such odour features as odour intensity or odour hedonic tone of a complex multicomponent mixture of odorants have not been investigated yet. It is proved that odour intensity of a two-components mixture of odorants can be appointed with an e-nose by comparison results of signals from a surface of a sensor layer (surface distribution) with odour intensity assessments obtained with an olfactory method [1]. GC-NN system enables for appointing various odour features of any odorants mixture on the basisof a chromatograph detector signals (time distribution).

## AIM AND SCOPE OF THE RESEARCH

Perspectives of GC-NN method development depend on a trained network capabilities to eliminate information about odourless compounds (no-odour impact) present in an analised sample and recorded in chromatographic data.

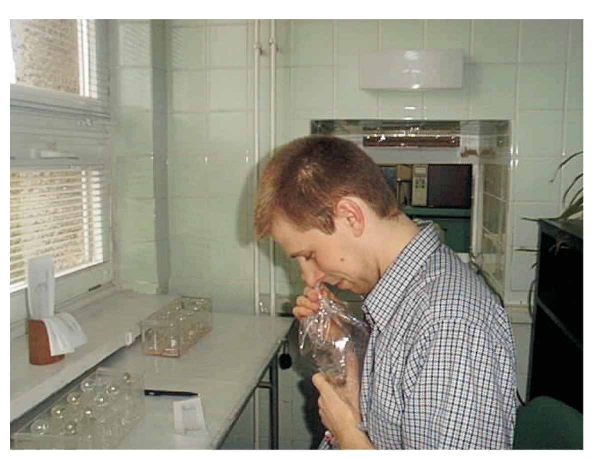
Effects of training neural networks prepared for determining odour intensity of acetone on the basis of information about its concentration in the air, delivered simultaneously with information about concentrations of several to twenty neutral odourless pollutants (information noise) were investigated.

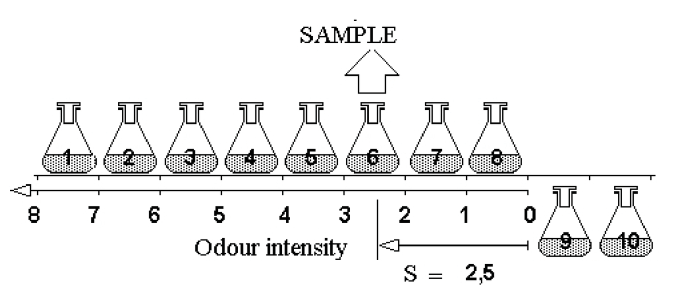
311 individual odour intensity assessments of 24 air samples acetone (concentration of 110-16500 mg/m$^3$) were collected. Results tables were extended by introducing 20 additional columns with 1 to 20 randomly chosen non-zero hypothetical concentartions of neutral pollutants.

Results of calculations, performed with networks prepared in conditions of information noise and without the noise, were compared.

## RESEARCH METHODOLOGY

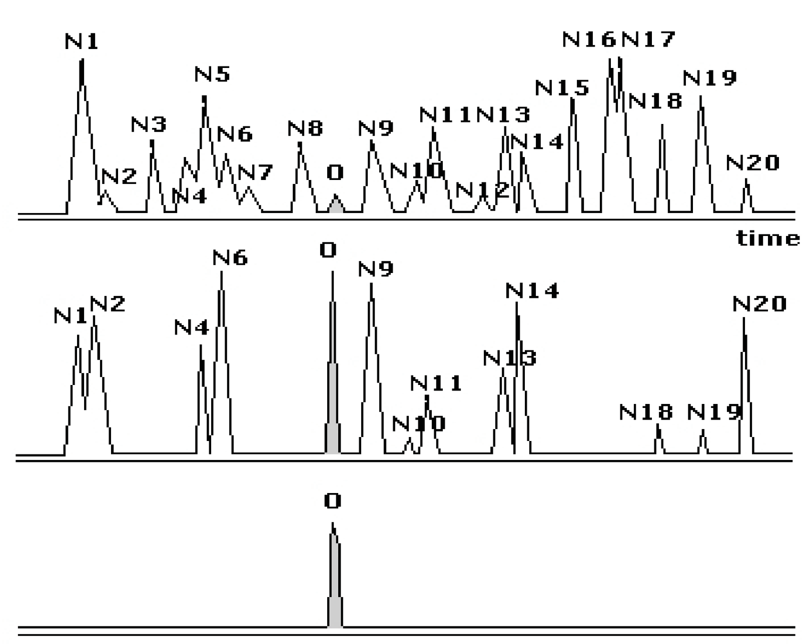
### Chromatographic and sensory analysis




Samples were prepared by introducing different amounts of acetone with Hamilton syringes (5 µl, 10 µl, 5ml) into Toppits Melitta sample bags containing approximately 15 dm$^3$ of pure air induced with a Stroehlein gas cylinder. Odour intensity was assessed by five students groups (12-15 people in each group after a short training session) with n-butanol scale of standards (geometrical sequence of 2,86 step factor) in a laboratory equipped with a highly-effiecent air conditioning system. The samples were simultanously analysed with LABIO GC 07 chromatograph with FID detector column: 2m, 4 mm; PEG 20M (15%)/Chromosorb WAW 80/100 mesh.

### Neural network training sets preparation




N1 - N20 - hypothetical neutral odourless compounds present in the air together with one odorant (O).

To investigate neural network abilities to appoint odour intensity of air mixtures consisting of one odorant (acetone) and one to twenty odourless pollutants neural network training sets were prepared.

Each set contained one column filled with a logarithm of acetone concentration and twenty columns of hypothetical, randomly chosen logarithms of odourless compoundsconcentrations.

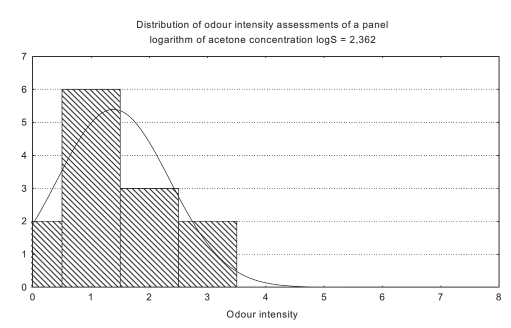
In consecutive network trainings the level of noise was changed by filling in more andmore columns with non-zero numbers (in the rest of the columns zero values were left).

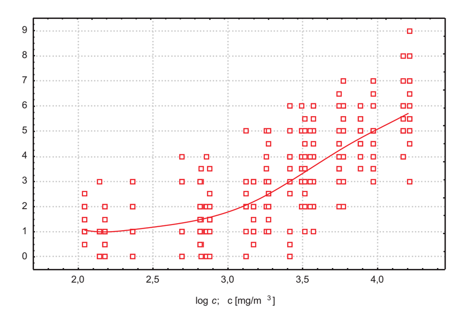
Neural models were obtained with Automatic Network Designer, Statistica Naural Networks (StatSoft).

Quality of neural models obtained in conditions of information noise was assessed by comparing their results with odour intensity values obtained with a "reference model".

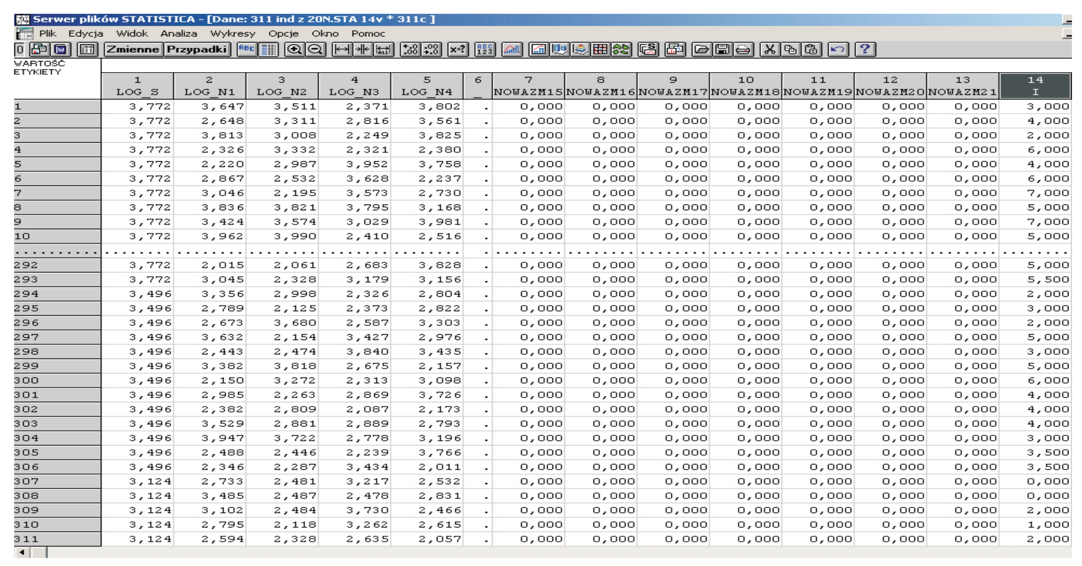
The model obtained in conditions of the information noise absence (concentrations of odourless equal to zero) which allowed to obtain the smallest value of RMS Error of approximation was used as a reference model.

## RESULTS

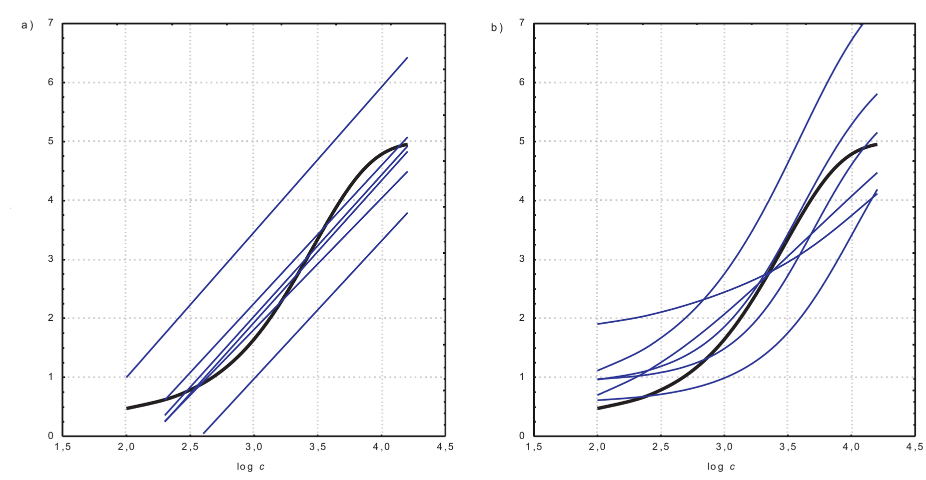


The figures present differentiation of odour intensity assessments of an acetone sample in a gropu of 13 panalists (fig. a) and of all 24 analysed samples of acetone by five group of panelists.



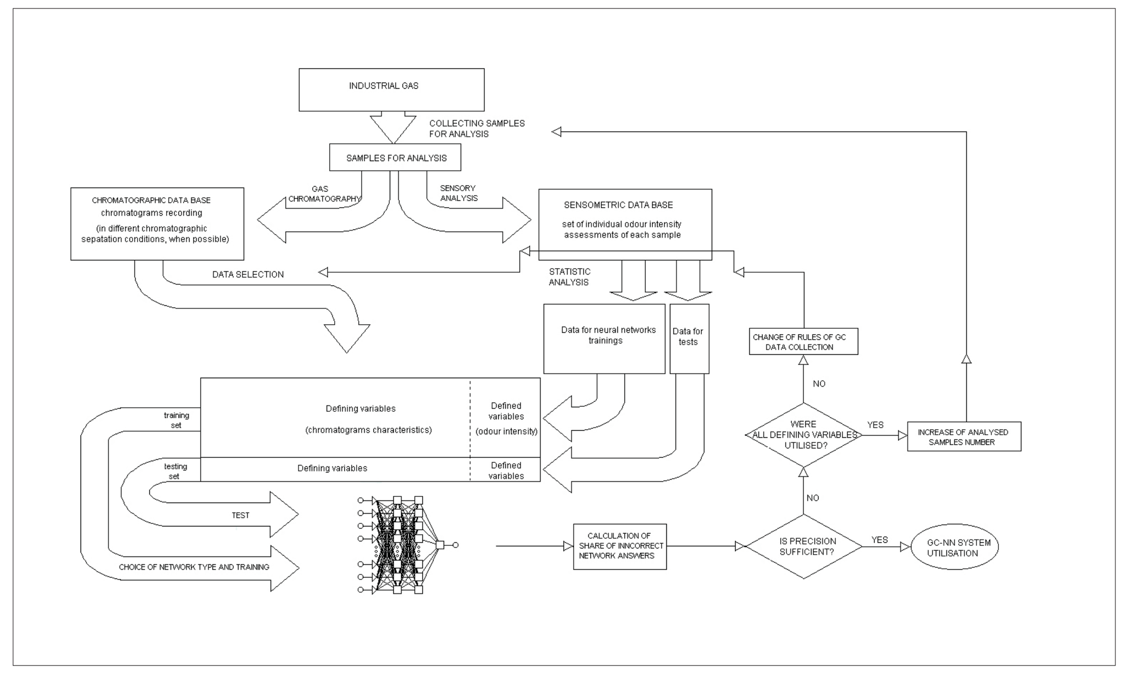
Results of sensory-chromatographic measurements were collected in data set consisting of 311 cases, 22 variables. The first variable was logarithm of acetone concentration,the next 20 columns were logarthms of non-odorants (zero and non-zero values). The last column consisted of odour intesnsities of the samples analysed by the panel.




Comparison of the reference neural model (MLP, solid bold line) with models generated in conditions of information noise (6 odour-free pollutants): a) linear models, b) MLP model

Results of neural network trainings are presented by the dependencies of odour intensity (blue line-calculated by a neural model, black line - assessed by a human panel) on logarithm of acetone concentration (c, mg/m$^3$).
Most of the obtained model allowed for determining odour intensity with precision of 0,5 degree of odour intensity scale (similar or greater than differences between panel sensory assessments of one sample).

## POTENTIAL APPLICATIONS



## CONCLUSIONS

When preparing a neural model enabling for odour intensity determining on the basis of various instrumental measurements, data sets consisting of results of direct sensory assessments and all measured values (significant and insignificant from odour point of view) can be used.

Training sets consisting of approximately 300 patterns (individual odour intensity assessments) are sufficient for preparing a network which correctly defilters one significant piece of information out of six insignificant ones.

It is planned to make trials of improving obtained network models quality by using opinions of a selected group of assessors or using a method of backward experimental data screening.

## REFERENCES


[1] Hudon G, Guy C, Hermia J.: Measurement of odor intensity by an electronic nose.Air Waste Manag Assoc. 2000 Oct;50(10):1750-8.
[2] Kośmider J., Zamelczyk-Pajewska M., Krajewska B.:Odour intensity of industrial gases. An alternative of instrumental measurements. Ochrona Powietrza i Problemy Odpadów 2 (2004), S.54/61
[3] Kośmider J., Zamelczyk-Pajewska M.: Odour intensity assessments using GC-ANN method, [in proceedings:]The Sixth Sense, 6th Sensometric Meeting, July/August 2002 Dortmund, S. 59/61