TECHNOLOGY

Based on the simple idea that it should be possible to quantify and characterise any particle suspended in solution, regardless of the sample matrix, Figura combines nanopore technologies with analysis algorithms that deliver precision measurements to every user.

What does Figura do?

Our technology can simultaneously count and size particles between 0.1 and 100 microns, with no sample preparation. The analysis algorithms also offer information on aspect ratio helping identify contamination of the characterisation of materials.

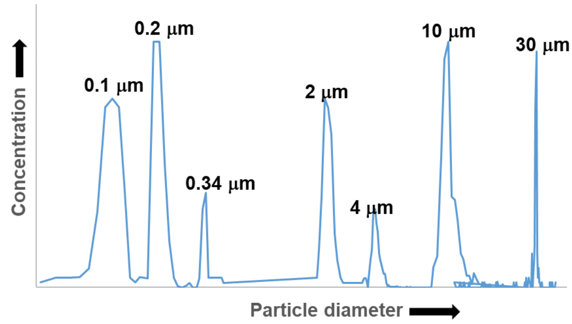


Figure 1. Example of the particle size range measured on the technology

How it works?

Resistive pulse sensors have been used to characterise everything from whole cells to small molecules. Their integration into microfluidic devices have simplified sample handling whilst increasing throughput. Typically, these devices measure a limited size range or a specific analyte, making them prone to blockages in complex sample matrixes. Figura created a multi-RPS sensor, the orientation and controlled fluid flow in the device allows the sensors to be placed in series, whereby smaller particles can be measured in the presence of larger ones without the risk of it being blocked.

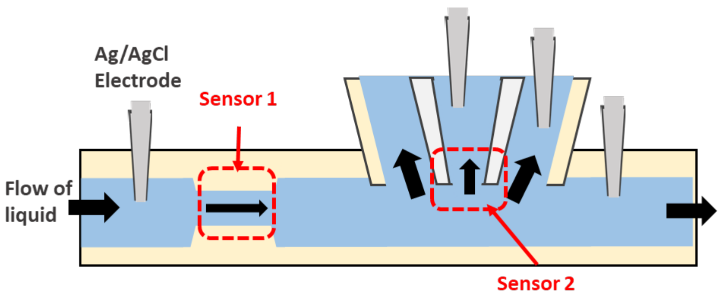


Figure 2. Schematic of the flow cell. Sensor 1 and 2 are both capable of being tuned to measure a range of particles. With subsequent sensors being placed in series.

By controlling the fluid flow in the device several RPS sensors can be placed in series, whereby smaller particles can be measured in the presence of larger ones without the risk of the pores being blocked.

FIGURA ANALYTICS

SIZE AND CONCENTRATION

Each translocation of a particle through our sensor produces a pulse/ peak. The magnitude of the pulse, known as the pulse magnitude (Δi_p) is related to the volume of the particle, and the full width half maximum *(FWHM)* of the pulse relates to the flow rate. Each sensor within Figura's flow cell, counts the number of particles within a specific size range.

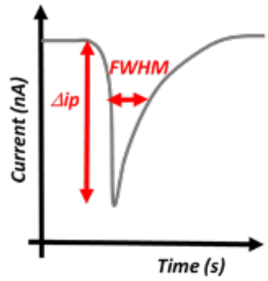


Figure 1. Example of the resistive pulse.

Particle size

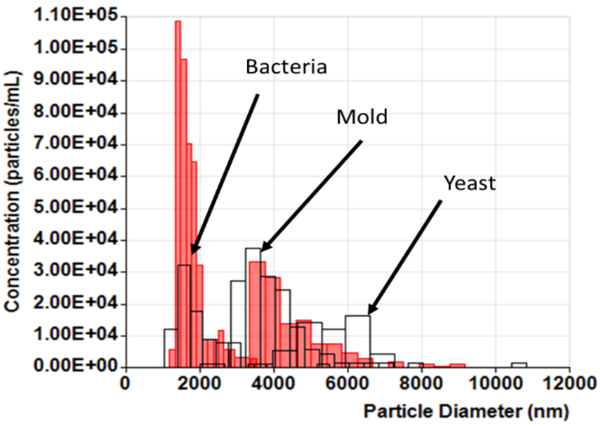


Figure 2. Examples of particle size data.

The magnitude of the pulse is directly proportional to the particle volume. Each sensor is calibrated at the start of the analysis. The sizes presented in Figura data sets are placed into units of particle diameter. The system actually measures the volume of the particle/ cell, for spherical particles the number on the x axis is the true particle diameter.

When the particle being measured is non-spherical Figura initially takes the measured volume and calculates the diameter of a sphere with equivalent volume. As such the sizes reported for each microorganism may differ from their true size. The shape of the particle is then detected via the Shape identification software.

Particle concentration

The number of pulses observed is directly related to the concentration of the particles in the solution, and the flow rate of the liquid through the sensors. By controlling the flow rate through the flow cell we can detect particles as low as 10 particles/ mL.

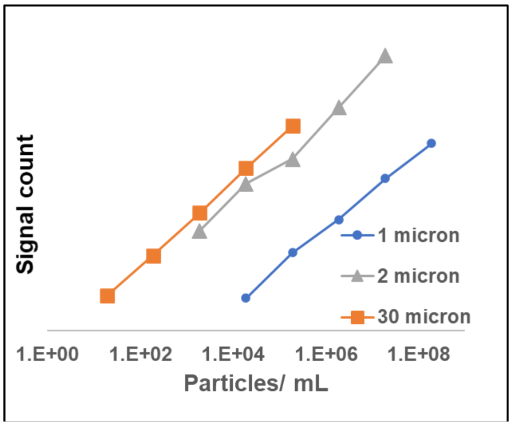


Figure 3. Pulse frequency versus concentration.

SHAPE ANALYSIS

Figuras technology is based upon the principles of resistive pulse sensing, RPS. Each translocation of a particle through the RPS produces a pulse/ peak. The magnitude of the pulse, known as the pulse magnitude (Δi_p) is related to the volume of the particle, and the full width half maximum *(FWHM*) of the pulse relates to the flow rate.

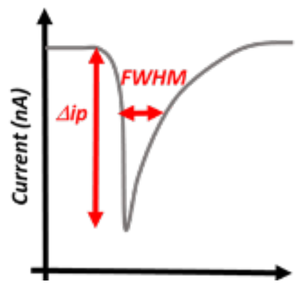


Figure 1. Example of the resistive pulse.

Figura's unique IP uses the shape of the peak to determine the shape of the particle, i.e. a rod shaped bacteria looks different then a spherical flavour particle. The shape identification software extracts the features of each signal in real time and assigns a probability to each one as a typical/ spherical particle, or contamination/ microorganism.

The model can be trained for each customer and drink formulation. Creating a library of "normal" particles against a library of microorganisms.

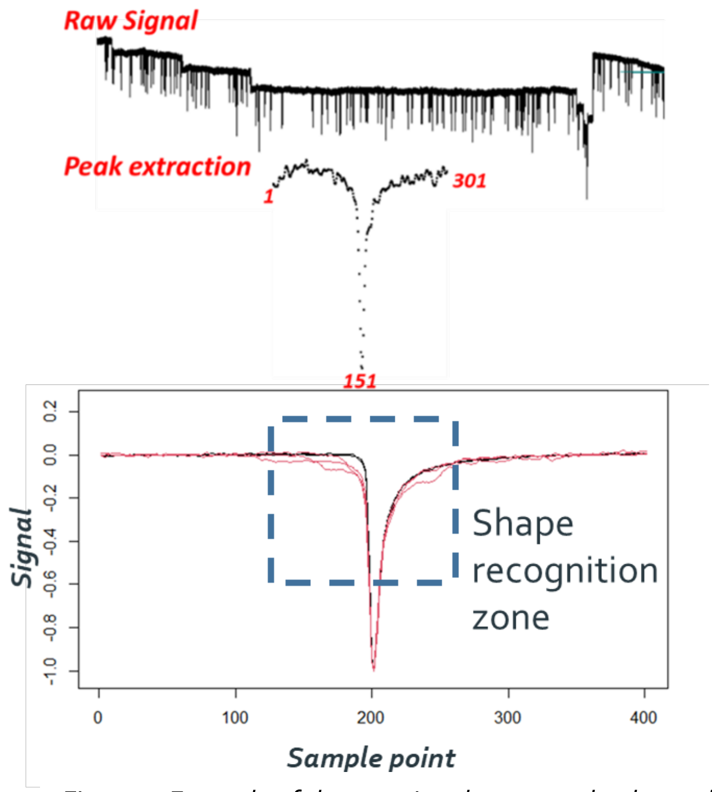


Figure 2. Example of the raw signal, extracted pulse and overlap of typical spherical particle signals (black) versus E.coli (red)

The shape of the pulse is characteristic of the particle shape and aspect ratio.

MICROORGANISM DETECTION

The number of pulses observed is directly related to the concentration of the microorganisms in the solution, each sensor within Figura's flow cell, counts the number of particles within a specific size range. Here the sensor is tuned to detect *Lactobacillus Brevis*.

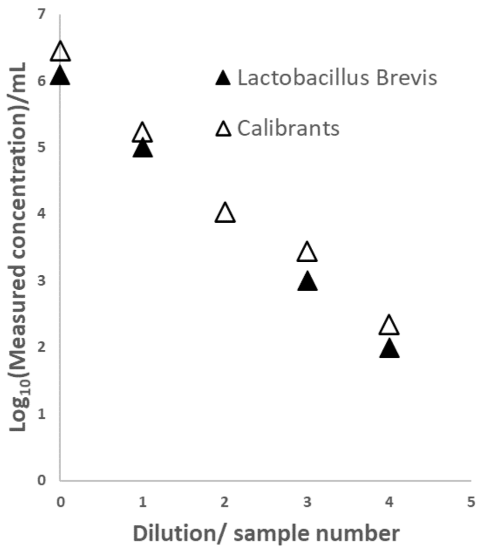


Figure 1. Measured concentration of Lactobacillus Brevis versus dilution factor

The signal frequency is directly related to the number of cells in solution, and using our shape analysis software, the signals are counted, sized and then further classified as being non-spherical.

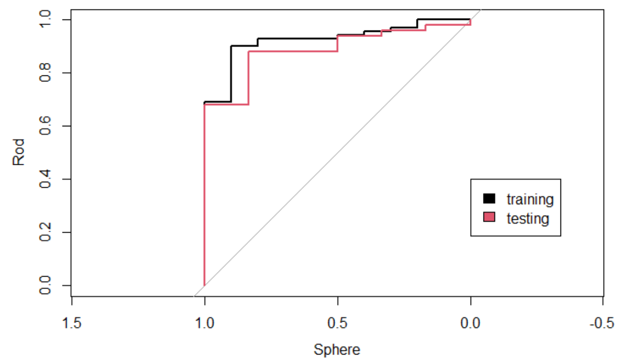
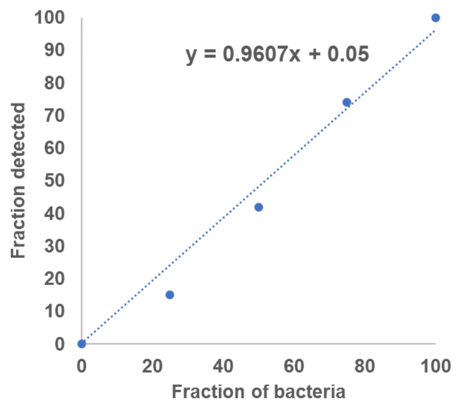


Figure 2. Example of ROC: Sensitivity versus specificity. Each target organism and sample matrix is used to create a bespoke analysis algorithm.

The shape analysis algorithm runs automatically, requiring no user interaction/ analysis or interpretation. Each algorithm is stored within Figura's software.



Our unique shape recognition feature allows the bacterial particles be to identified even in the presence of a high concentration of spherical particles of equivalent volume.

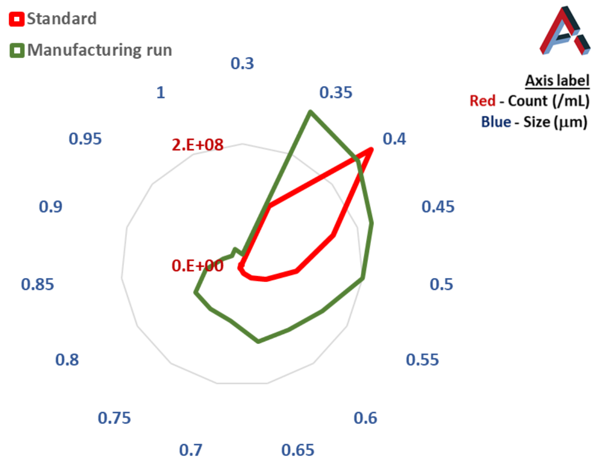
Figure 3. The accuracy of the software is shown, with the measured number of bacteria versus the known fraction of bacteria in a solution containing spherical drink particles.

FIGURA ANALYTICS

PARTICLE SIZE ANALYSIS APPLICATIONS

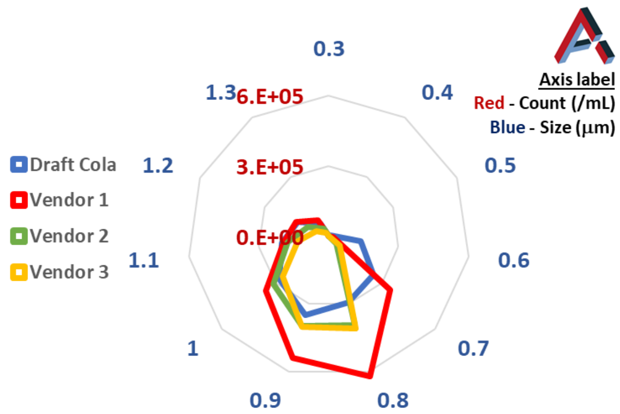
Our technology can simultaneously count and size particles between 0.1 and 100 microns, with no sample preparation. As Figura screens each drink for signs of microbial contamination, the device is also characterising the particle finger print of every sample. This allows the manufacturer to see signs of sample degradation, inconsistency in the drink formulation, non-microbial particle contamination, salt concentrations and more.

e.g. Is there evidence of inconsistent manufacturing process?

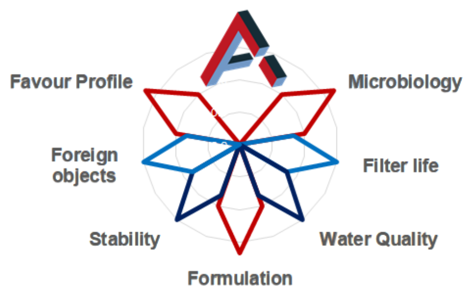


By monitoring the particle fingerprint of a product, variations in manufacturing runs can be easily identified. Here the standard particle size range of a product is shown in red. A manufacturing run where the formulation doesn't meet the specifications are shown in green.

e.g. Is there evidence of sample deterioration?



By monitoring the particle fingerprint of a product at various locations and time point deterioration of a product can be spotted.



Other applications

- Filter quality
- Water conductivity
- Beer haze and polyphenol quantification

FIGURA ANALYTICS