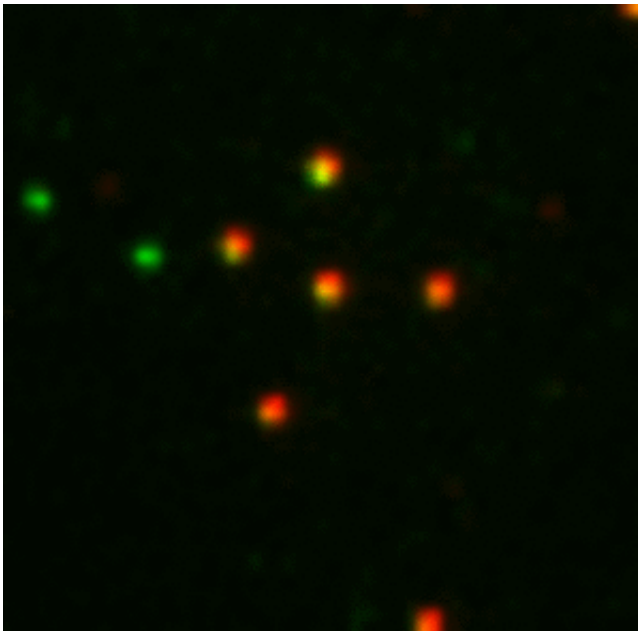


A single molecule in the building blocks of life

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SmFRET measurements that record how individual molecules (the green/red dots on the image) change their structure as a function of time. Changes in the molecular structure are reflected by the color of the dots and their intensity.

Credit: Aarhus University

The world is built up of molecules that join together and form different building blocks. New software makes it easier to zoom right in to the individual molecule.

Have a look round your living room. Everything around you is made up

of [molecules](#) - just as you are. When they are put together, the molecules act as the building blocks of life. Every single building block has a very small effect and we normally relate to the finished things. However, there are scientific disciplines that have specialised in looking down at the individual molecules to understand how they work and especially what happens when something goes wrong with the [building blocks](#).

Molecular Pacman

Research into individual molecules is about understanding the components and using this as a gateway to learning more about the correlations. In figurative terms, it is like observing cats at night. They all appear to be grey, but we have to recognise their colour individually to distinguish them from each other. Researchers all over the world who work with molecular biology, nanoscience, chemistry and physics are carrying out multidisciplinary work in this area. To a great extent, they make use of a measuring method called single-molecule fluorescence resonance energy transfer (smFRET), which takes measurements of distances between molecules right down to 2-10 nanometres.

Molecules are not static, but can move, open and close - something like the Pacman game of the 1980s. Their structure and movement patterns have an impact on how they interact with other molecules, which is why the researchers are interested in being able to describe them.

Individual molecules provide new knowledge

"If we can visualise and characterise a single molecule and see how it interacts with the other molecules, we can understand what is going on in the individual event. Once we understand the mechanisms behind this, we can begin to work on controlling how the molecules work, so that this takes place at the most advantageous times," says Associate Professor

Victoria Birkedal, who carries out research into the understanding of individual molecules at the Interdisciplinary Nanoscience Centre (iNANO), Aarhus University.

Easy access to better data

Associate Professor Birkedal's research group has developed new software that makes it much easier to obtain rapid and precise data following an smFRET analysis. The group has just published an article about the software in the prestigious journal *Nature Methods*.

The software provides easier access to data that would otherwise be time-consuming and laborious to obtain. Only a few specialists have previously been able to process the data. However, the program now makes it accessible to a wide circle of researchers.

From dot to structure

"We used to do data analyses during the night without really knowing whether they'd provide the answers we wanted. The program is so fast that we now get the results within a few minutes," says Associate Professor Birkedal. The program provides an innovative visual approach to data and enables the researchers to carry out faster and more precise data analyses. Seeing the individual molecules and analysing their behaviour gives graphic support that can be used in all research into individual molecules, but the Aarhus group uses it to look at biological processes in the body.

"A molecule is very, very small, but it's no longer just a dot. We can see its structure and how it behaves, and try to understand why it does what it does," says Associate Professor Birkedal.

The next step is to control the molecule's structure so as to get it to behave in a particular way - something that can be used in targeted medicine.

Democratic software

The group has decided to make its software freely available to everyone. "We'd like to democratise access to data," says Associate Professor Birkedal, who is pleased that the [software](#) opens up for easier opportunities to work together at a distance. The program has been well received wherever it has been presented.

More information: iSMS: single-molecule FRET microscopy software, *Nature Methods* 12, 593–594 (2015) [DOI: 10.1038/nmeth.3435](#)

Provided by Aarhus University

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