NPL
National Physical Laboratory

METROMNIA

Inside the world of measurement science & technology

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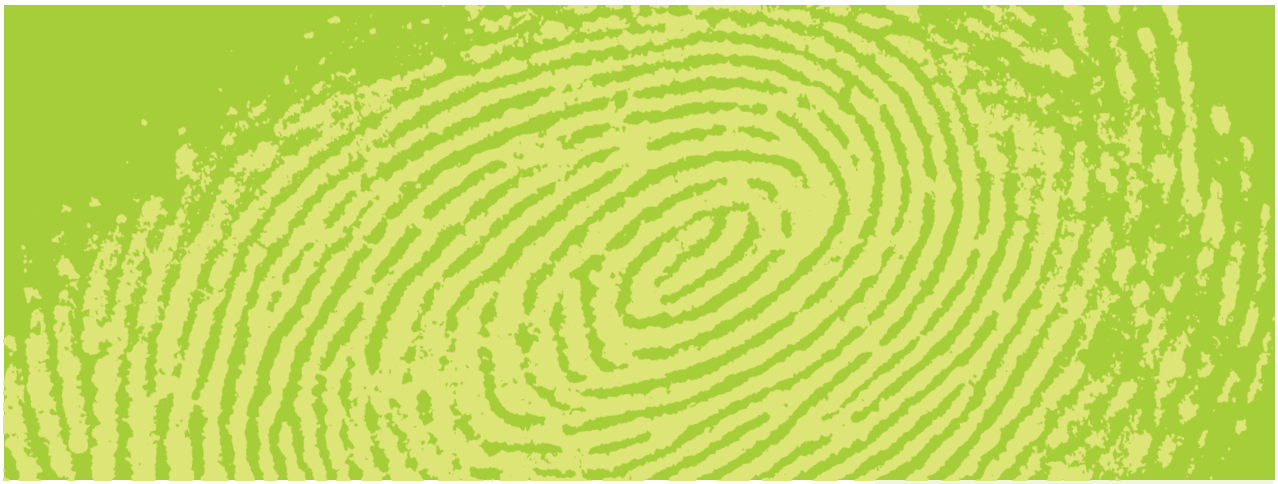


Not just ID cards

Tony Mansfield collects fingerprints. At last count, he had 160,000 of these unique biometric markers under lock and key at the National Physical Laboratory (NPL).

Europe, a leader in fingerprint biometrics, has called for the use of this technology in future travel documents and visas. Dr Mansfield is leading a team of EC partners in a major project to make sure different equipment provides the same results no matter where it is used.

A person's fingerprint may be captured and stored in the UK using a particular type of equipment. Border officials who check the identity of that person in a different country may not be using the same kit, so it is vital they at least use the same standards and that systems are compatible.

The vast database of fingerprints in Dr Mansfield's office has been painstakingly collected from thousands of people who provided prints using several different devices. They are being treated as confidential information and are not linked to the identity of their owners.

"The success of biometrics depends on accuracy and public confidence," Dr Mansfield says. "We are making sure that every device used to collect fingerprints, or to identify people based on their biometric records, works in a sufficiently similar way."

NPL has internationally recognised credentials in performance testing, measurement and calibration of biometric systems and Dr Mansfield has advised Parliament's Science and Technology Committee on biometric issues around ID cards.

Ambient identification

Dr Mansfield expects biometrics to reach critical mass when it is widely used by government agencies.

But biometrics has applications way beyond border posts and passport control. Personal computers or mobile phones with built in biometric systems may soon be able to specify the individual permitted to access particular information, as well as allowing biometric authentication of bank transactions.

Systems currently require individuals to make an effort to be recognised. Future ambient biometrics may be able to identify individuals when they walk into a room. They could also be installed on potentially hazardous machinery so only trained operators can use it.

Why fingerprints?

Distinctiveness, repeatability and ease of use all make fingerprints a good biometric.

The public is familiar with fingerprinting, which has been used since the 19th century and popularised in films and television.

Fingerprints are sufficiently unique that they remain the most commonly used forensic evidence worldwide.

About biometrics

Biometrics, the science and technology of measuring and statistically analysing biological markers, is emerging into the mainstream. It has captured the imagination of governments, security agencies and the public. Research and deployment of biometric security systems has accelerated following the need for increased security as a more stringent approach to personal identification is adopted.

NPL is helping to evaluate the state of the art in biometrics, and is guiding suppliers in their deployment.

Besides fingerprints, current biometric markers include faces, eyes, vein patterns on hands or the retina, voice recognition or signature systems.

"Different systems suit different jobs, and complicated solutions aren't always best," says Mansfield. "If people are used to signing their names for a particular application, then perhaps the most optimal biometric system can be built around that."

Lead scientist Ken Vassie tests the new Ambient Illumination Laboratory (AIL) - the only commercial facility of its kind in Europe.

Shedding light on displays

Sunlight is annoying when it makes it hard to read an e-mail. It can be dangerous if a driver can't see a dashboard display at speed. NPL is developing techniques which will lead to improved readability of displays in a range of lighting conditions.

Responding to the emergence of display technology in everything from mobile phones and cars to billboards and buses, NPL is using light measurement techniques to develop specifications for display readability and luminance (brightness). The first project for NPL's new displays team is to measure readability in top-end sports cars using techniques based on military calibration methods.

Using NPL's specifications, manufacturers will be able to identify the most appropriate display settings for different situations and give suppliers clear guidance on which displays are suitable for their products.

Sensing the sun in their eyes

Evaluating the visibility of a display is difficult. The challenge increases in a moving car, where shifting reflections from bodywork, windows and passengers can affect visual performance. The geometry of different vehicles makes it even harder.

"It is also important to factor in human perception because not everyone will see a display in the same way," notes NPL research scientist Ken Vassie.

Vassie and his team pioneered NPL's new Ambient Illumination Laboratory (AIL), the only commercial facility of its kind in Europe. It provides the ability to simulate any illumination scenario under which a display will be used.

Measurements are taken of the spectral content and luminance of the display, the illumination of the environment, light falling on the display and in the user's field of view.

The AIL can help any organisation use visual displays to maximum effect, from passenger information at railway stations to advertising hoardings on the road.

Faking it with *Style*

Can a fake ever be as good as the real thing? Would consumers accept synthetic versions of natural products if they looked and felt authentic? By better understanding the characteristics of natural materials, scientists can help manufacturers make more realistic products while relieving pressure on natural resources.

Consumers view themselves as reliable arbiters of their own good taste – and make important buying decisions based on an ability to tell natural items from their synthetic imitations. But few people can say how they came to their conclusions.

For many manufacturers it is easier and cheaper to manufacture imitation products than to mine or harvest their natural equivalents such as wood, stone or fur.

A natural solution

NPL is leading a multidisciplinary team researching how physical characteristics of materials affect sensory systems and human judgements.

A sequence of complex measurements is being taken by physicists, measurement scientists, neuroscientists and psychologists. The specific physical characteristics of a surface, such as reflectivity and roughness, are being linked to neurological and emotional responses.

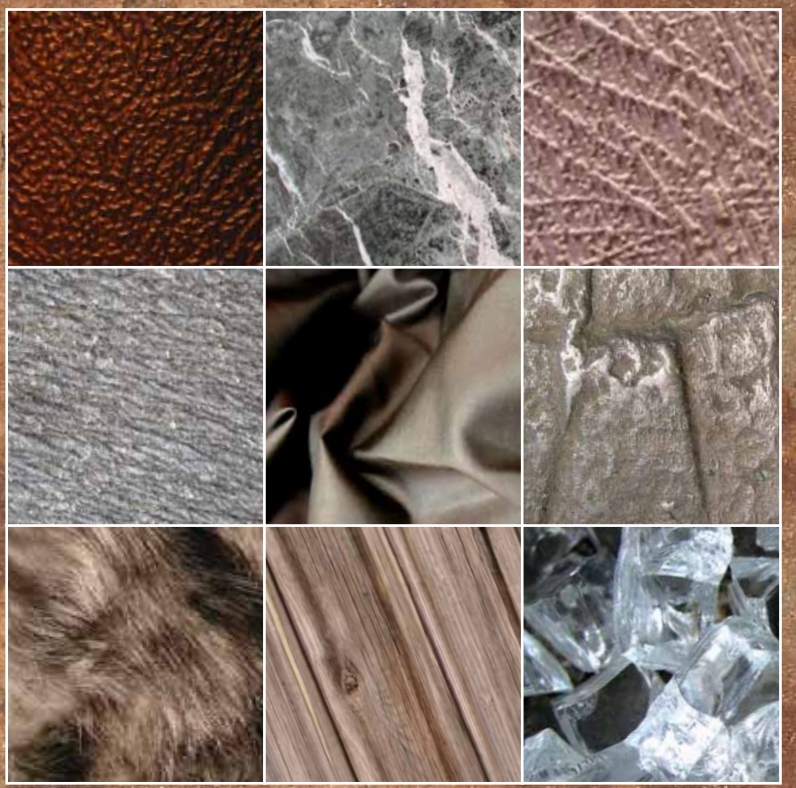
"This is important work that nobody has undertaken before," says Teresa Goodman, the lead scientist for human factors research at NPL.

"Consumers will often pay a higher price for something they regard as natural. But the highest price is paid by the environment when natural materials come from a shrinking pool of resources."

The naturalness research is part-funded by the EU's Framework 6.

Measuring the impossible

To understand how a product is perceived by the human eye, scientists need detail of how it absorbs, reflects and scatters light. NPL is developing a new instrument called IRIS (Image Replicating Imaging Spectrometer) which captures multiple images of a surface, each featuring a particular spectral region. IRIS will be used in equipment measuring the reflections of light shone on a surface at different angles. By changing the angle, researchers can measure how light influences depth, texture and colour perception.



Why manufacturers like synthetic materials

Environmental impact – natural products come from finite resources and may have a negative impact on the environment and communities

Reliability of supply – synthetic materials come from more reliable sources

Robustness – many natural materials are vulnerable to vigorous use and may degrade over time

Matching – replacement parts are easier to match to the original if they come from exactly the same source

Product design – a steady supply of synthetic materials gives designers new options when considering the functionality or appeal of a product

Fingertip research

An artificial finger tip is being built with sensors that respond to the feel of a surface and measure pressure, movement, friction and roughness. This is useful to inspect surfaces which feel different depending how they are touched - such as wood, velvet or human skin.

Measurement and perception

Scientists at NPL have long been interested in the relationship between human perception and pure physical measurements, a branch of science known as psychophysics.

"You can't view one characteristic of a product in isolation from the effect it has on the complex psyche of a consumer," Goodman says. "Our experience of the world is also based on the senses, so it is important that we are able to make measurements to predict these sensory impressions."

Natural benefits?

The naturalness project may lead to improved product design, a better understanding of what customers want, and less exploitation of vulnerable natural resources. Well over 50% of products fail because consumers simply don't like them. Data gathered by the project may help to build models which predict in advance whether consumers would like something.

The word nature derives from the Latin word natura, a translation of the Greek word physis, a philosophical or scientific term related to the natural growing of plants of animals. For the purposes of this research project, scientists have agreed to define naturalness as the 'probability that a material or object is perceived as being natural'.

Blue sky research

When a travel company inspired a round-the-world mission to find the bluest sky, NPL made sure the results were accurate.

The winner of an Expedia competition, Anya Hohnbaum, was last year challenged to identify the best holiday sky. NPL's optical radiation team provided the tools to support the measurements she took from beaches and mountains across the world.

The challenge was to adapt laboratory techniques for the 64,000 mile journey and make sure the kit would survive 72 days of hard travel in 19 countries and on 56 aircraft.

NPL wrote software to analyse the data and created a schedule so each test was at the same solar time regardless of location. Blueness readings were taken with a spectrometer – which splits light into its constituent colours and measures levels of each colour present.

Each set of readings produced a set of numbers representing the colour of the sky. These were plotted on a chromaticity diagram which showed their relative positions and closeness to the bluest part of the colour standard.

The clarity of the sky was measured by taking two further spectrometer readings, one of light directly from the sun, and one of scattered light.

Blue Sky top 5

1.	Rio de Janeiro, Brazil
2.	Bay of Islands, New Zealand
3.	Uluru, Australia
4.	Denarau Island, Fiji
5.	Cape Town, South Africa

NPL research underpinned the international standard for colour measurement which was first adopted in 1931 and is still the basis for all colour measurement and specification today. Colour standards are important to industry and play a role in everything from paint and chemicals to beer, textiles and food.

The new dawn of time

The time signal used to set Britain's clocks with extreme accuracy is on the move from Rugby, where it has been transmitted since 1927, to a new home in Anthorn on the west coast of Cumbria. It will become known as 'The time from NPL' from 1 April next year.

The time signal is accurate to within a thousandth of a second and supports a wide range of professional services, including 999 communications, train companies, cash machines and mobile phone billing systems. It helps synchronise servers for businesses and enables packet-switching, which is used to send and receive information across the internet. The frequency at which the signal is broadcast (60 kHz) is so accurate it is used by frequency calibration laboratories to tune and standardise equipment, and by television and audio repair companies as a reference.

Keeping things ticking along

The signal's transmission is tied to NPL's atomic clocks at Teddington in south west London. NPL is home to the UK's atomic time and one of only five laboratories worldwide using the latest caesium fountain to contribute to Coordinated Universal Time (UTC).

TIME FROM NPL
forever accurate

NPL has been responsible for the time signal since 1950. The transition to Anthorn on 1 April 2007 follows a three-month test period. Most users need take no action to continue receiving the signal though they may wish to sign up for information about planned interruptions for maintenance and testing. During these periods the signal at Anthorn will be switched on to allow users to ensure their equipment can receive it before the Rugby signal ends. Further information is available on the NPL website at: www.npl.co.uk/time/msf

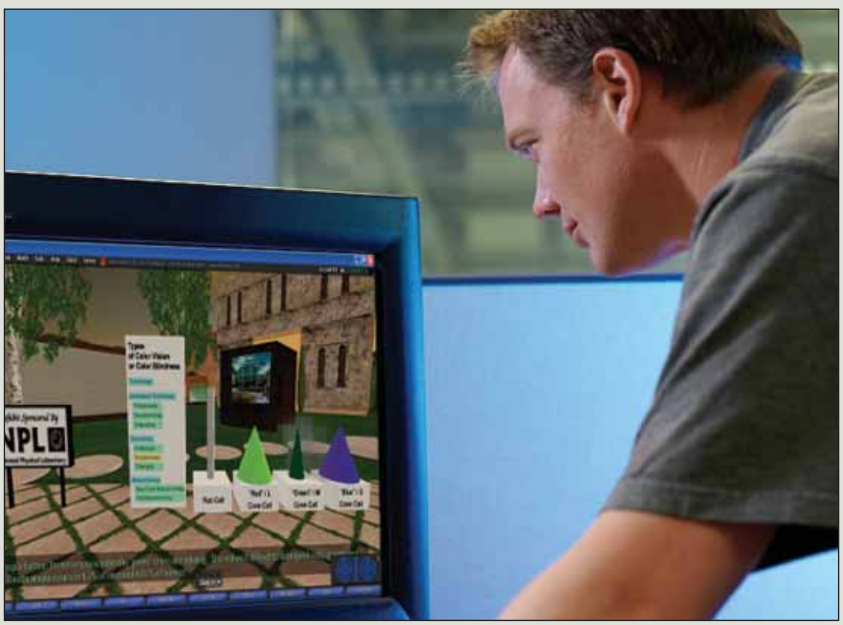
NPL's second life

NPL is one of the first national research laboratories to exist in Second Life (SL) – an online three-dimensional world where users can explore, build, socialise, and participate in their own economy.

NPL has always been an early adopter of new ideas, and a pioneer of networking technology since NPL scientist Donald Davies invented packet-switching in the 1960s.

NPL has built a 3D model of its TRUTHS concept satellite in SL. Another NPL exhibit explains the science of colour blindness.

SL offers unique opportunities for NPL to communicate its research, says knowledge transfer leader Dave Taylor. "It can be used for all kinds of scientific knowledge transfer and helps support collaborations due to the richness of interactions that can take place," Taylor says. "Users can communicate with each other without disrupting meetings and conference proceedings – this was useful when presenting a lecture on TRUTHS and earth observation satellites in SL."



Courtesy of ABSTILL

Science is becoming increasingly collaborative and international. NPL is looking at the use of SL in managing international research and collaboration with an EU-funded project.

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Burning green

NPL is giving energy companies the confidence to build cleaner and more efficient power stations across Europe.

Power stations can increase efficiency and reduce environmental impact by operating at higher temperatures. Traditional plants operate at up to 590 °C. New power stations operate above 620 °C and the next generation will need to go beyond 700 °C.

Pushing the limits

But materials and coatings are approaching their limits and may deform or degrade at higher temperatures. More resilient alloys are being developed, but not enough is known about their life expectancy. The inability to accurately predict their performance could lead to huge maintenance costs or serious accidents.

Experts at NPL are working with the power industry to characterise new alloys and develop measurement techniques which track their performance in harsh environments. One of the challenges is to develop techniques which predict performance over decades.

Built to last

"We need methods to evaluate these new materials so we can predict how they will perform over forty years," says NPL research scientist Tony Fry. "If we know more about them they become more predictable, which increases safety and lowers the cost of maintenance."

NPL is one of the UK's leading sources of research for the energy sector. In addition to new materials for power stations, its scientists are developing modelling tools to make fuel cells more reliable and efficient, and helping the wind power industry minimise maintenance costs.

Free measurement posters

Did you know an atomic clock stays accurate to within one second in 60 million years? Or that electricity was discovered as early as 600 BC when our ancestors rubbed together pieces of amber to create a charge?

NPL's colourful measurement posters cover topics from atomic timekeeping and acoustics to mass and colour.

Get your free set of posters and receive future editions of Metromnia by e-mailing **enquiry@npl.co.uk**

Time for TRUTHS

NPL's proposed TRUTHS calibration laboratory in space may help silence climate change sceptics by increasing the accuracy of earth observation data.

Information from satellites ought to provide unequivocal evidence to support national and international legislation, but most of it can be disputed because the instruments produce slightly different results.

The problem lies with calibration. Sensitive measuring devices on earth are regularly calibrated against primary physical standards, but this is not possible for instruments in space.

It is not viable to bring these instruments back to earth so NPL is proposing to send TRUTHS (Traceable Radiometry Underpinning Terrestrial and Helio Studies) into space. A master device in orbit, against which other earth observation satellites are tested and calibrated, would mean every instrument is working off the same measurement benchmark.

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