Maths matters

A series of short case studies describing modern mathematics research, produced by the IMA and funded by EPSRC.

Advancing the Digital Arts (PDF, 1.66MB)

The computer animation industry relies on a steady stream of mathematics to produce the fantastic images found on our cinema and television screens. Advances in mathematics also fuel developments in other areas of 3D modelling, such as car design.

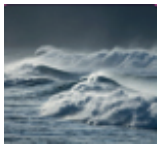
An Energy Evolution (PDF, 2.18MB)

As oil supplies become harder and more expensive to reach, it's essential that we maximise the yield from available reservoirs in any way possible. Mathematicians are contributing with a tool inspired by biological evolution that seeks out the best way to extract the oil.

Building the Digital Society (PDF, 3.44MB)

Computers and networks stuffed with ever-increasing amounts of data are transforming our society, creating a digital world with its own rules and behaviours. We need mathematicians who understand this new world and can turn data into useful information for the benefit of society as a whole.

Danger: Rogue Waves (PDF, 3.34MB)

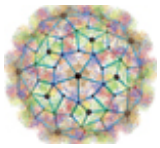


Rogue waves appear without warning, towering high over ships and oil rigs. Traditional mathematical models couldn't predict the occurrence of these dangerous waves, but the latest techniques let oceanographers make accurate forecasts. The research helps to protect our trade, energy and food supply routes.

Faster Formula One (PDF, 1.72MB)

Every second counts in the fast-paced world of Formula One, so race teams use advanced mathematics to squeeze the best performance out of their cars. Computational fluid dynamics lets car designers quickly test out new ideas before deploying them on the racetrack.

Fighting Infections with symmetry (PDF, 2.40MB)



Many viruses have a symmetrical structure made from basic building blocks, and biologists have struggled to explain some of the more detailed shapes. Now, mathematicians are using complex theories of symmetry to reveal these viral structures, ultimately leading to new treatments for diseases.

Fusion: Fuelling the Future (PDF, 1.80MB)

With fossil fuels running out, the race is on to find the best power source for the future. Fusion, the process that powers the Sun, could be the answer and mathematics is crucial in designing the power stations that could copy it.

Go with the Industrial Flow (PDF, 1.98MB)

Many industrial processes involve the complex moment of fluids, but predicting fluid behaviour can often be difficult. Mathematical models of fluid flow can help to improve manufacturing efficiency and reduce costs, while also enabling new applications of fluids within industry.

Hydrogen: The Fuel in Water (PDF, 1.87MB)

In the search for cleaner and greener sources of energy there are many options on the table. Mathematics is helping to develop a method which harnesses the power of the Sun to unlock the energy of the hydrogen that lies hidden in water.

Keeping Hearts Pumping (PDF, 1.7MB)

Blood-related diseases can seriously harm patients' quality of life and even lead to death. Many of these diseases are caused by problems with the flow of blood in the body, and using mathematical models to understand how and why these occur can help save lives.

Kosovo: Mathematics on the Front Line (PDF, 2.35MB)

It is crucial that as UK armed forces continue to deploy to destinations across the globe, they have the best tools at their disposal. As such, mathematical analysis is playing an increasingly important role alongside tanks and guns in their military arsenal.

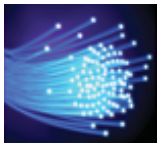
Modelling an Epidemic Emergency (PDF, 1.82MB)

Epidemics can threaten the lives of both humans and animals, so it is essential that we react swiftly to any outbreaks. Mathematicians play a key role in assessing the risks of disease transmission and modelling the effects of vaccination programmes.

Networking for the Future (PDF, 2.91MB)

Modern society relies heavily on a variety of networks, but we don't fully understand how they behave. Mathematical network theory lets us create models of our communication and transport networks, revealing new patterns and insights that will improve network capacity, reliability, and efficiency.

Optical Fibres: The Hole Story (PDF, 1.59MB)



The latest generation of optical fibres can be used for a wider range of applications, but their complicated internal structure makes them difficult to produce. A mathematical model of these new "holey fibres" promises to simplify the manufacturing process and reduce the cost of development.

Picture Perfect Processing (PDF, 2.37MB)

Mathematical image processing techniques make it possible for us to capture, transmit and store photographs and video. They also let us restore noisy or damaged images and extract useful information from visual data.

Predicting Climate Change (PDF, 2.74MB)

Our understanding of climate change draws on expertise from a variety of scientific disciplines, but climate models ultimately rely on advanced mathematical equations. Even the fastest computers in the world can struggle to solve these equations, so we need to deploy new mathematical

techniques in the fight against global warming.

Preserving Britain's Coastlines (PDF, 2.02MB)

Much of the UK's coastline is undergoing erosion, placing homes, businesses and other important coastal sites at risk. Mathematical modelling can enable us to understand both the short- and long-term processes that lead to erosion, and help protect the nation's coast.

Scans on the Brain (PDF, 1.87MB)

Brain scans play a vital role in the treatment of many serious medical conditions, but decoding the signals inside our minds would not be possible without a variety of mathematical techniques.

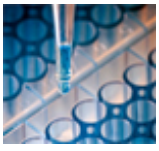
Smarter Phones for All (PDF, 2.63MB)

The amount of information we can transmit though the air is limited by the laws of physics, but the mathematics of signal processing lets us squeeze more data into the same amount of space. As a result, we get better, cheaper and faster mobile phone calls.

Statistically Secure Identities (PDF, 1.22MB)

It is essential that the biometric systems we depend on for national security can reliably identify individuals and aren't easily deceived. A range of mathematical techniques ensure these systems work as intended, helping to keep the UK safe.

Stats in Your Genes (PDF, 1.52MB)



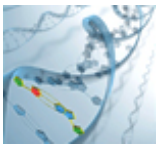
Sequencing the human genome was a fantastic achievement, but it was only the beginning. Now, statisticians are coming up with new methods to sift through large amounts of genetic data and identify the differences in DNA that can lead to diseases.

Taking Decisions, Not Risks (PDF, 1.41MB)

Risks are an unavoidable part of modern life, but mathematicians and statisticians have developed a variety of methods to help mitigate its

effects. These techniques enable hospitals, banks and other organisations to make better decisions, based on evidence and facts.

Unravelling the Genetic Code (PDF, 1.98MB)



Understanding how to manipulate tangles of DNA could help us create new treatments for diseases, so mathematicians are working with biologists to explain how our genetic code becomes knotted. Their work combines the latest technology with a centuries-old branch of pure mathematics.

Keeping an Eye on Diabetes (PDF, 1.2MB)

Diabetes is on the rise in the UK, but current methods of directly measuring patients' blood sugar levels have their drawbacks. Mathematics is playing a crucial role in finding a new, non-invasive, way to monitor the disease.

Train Delays Keeping on Track (PDF, 2.88MB)

Catching a train is part of daily life for many, whether they are commuting to work or heading for a night out. Mathematics could help negotiate the minefield of delays that often accompanies train travel, reducing the risk of arriving late, and so reducing the stress of travel.

Volcanic Ash: Air Travel Under a Cloud (PDF, 1.49MB)

The eruption of the Icelandic Eyjafjallajökull volcano in 2010 not only had newsreaders' tongues in a twist but called a halt to air travel across much of Northern Europe. It was imperative to get planes safely back into the skies as swiftly as possible and mathematics was at the heart of the solution.

Institute of mathematics & its applications

http://www.mathscareers.org.uk/viewItem.cfm?cit_id=383099