Described as a ‘cinema enthusiast for as long as he could remember’, technology expert Moshe Kam explored man’s fascination with moving images across the millennia – from cave painting in prehistoric France to prospects for sensory cinema in the future.

In France 30,000 years ago, the earliest known artists attempted to convey movement and perceptual depth in cave paintings. They sketched contours and added extra legs on bison to make them look three-dimensional and mobile. These early drawings, according to Moshe Kam, express man’s quest to depict moving and three-dimensional images – they represent a very early precursor to cinema as it developed from the late 19th Century to the present time.

In his talk, Professor Kam described the long technological route to current-day cinema, as well as the inspiration and motivation for the technology that enabled moving images. He also discussed the barriers and setbacks that cinema technology has encountered over more than a century of intense innovation and expansion. Kam spoke about technology as an enabler of new artistic expression, and on cinema as a catalyst for new technology in the inventor’s laboratory. He gave some intriguing glimpses into a future where cinema experience may well transcend sound and vision, and involve also the senses of touch, taste and smell.

Even before the invention of cinema, there were many attempts to create the illusion of moving images. The most advanced efforts involved the use of a series of still images, photographed or painted, and then projected in quick succession so that they were perceived by the human eye as moving. Such efforts, based on the theory of persistent vision, have been explored since the mid-19th Century, though the basic ideas were sown much earlier – they are even mentioned in preliminary forms by Euclid and Newton.

In the late 19th Century, however, three technologies converged to enable and accelerate cinema technology. These technologies were optical toys, photography and projection.

Early optical toys included the phenakistoscope and the zoetrope (or “wheel of the devil”), both of which employed permanent ‘hardware’ (mostly mechanical, cranked by hand) and replaceable ‘software’ – strips of painted images which were shown on the device. When these still images of progressive movement were viewed in quick succession, usually through a peephole or a slit, they gave the viewer an impression of movement. Another invention was the praxinoscope, a device made by Émile Reynaud, which led to his Theatre Optique – a 1892 moving picture show considered to be the first presentation of projected moving images to an audience. In the inaugural presentation, on 28 October 1892 in Paris, Reynaud showed three cartoons, each lasting about 15 minutes and consisting of 500–600 individually-
painted images. It was a one-man show; Reynaud served as photographer, writer, editor, producer and projectionist.

Only forty years later, the staffing situation was very different. Film was being described as “the nearest modern equivalent to a modern cathedral,” on the basis of the number of people involved and the diversity of their professional contributions, from directors to actors to soundmen. In 2013, however, we seem to be getting back to the one-man-band idea of cinema. The wide availability of film-making tools now enables the efforts of small groups, or even single individuals, who can create, with small crews and limited budgets, professional-grade cinematic works of art.

Professor Kam described the cycle of successful cinema inventions. First, a need is identified, or a physical constraint is described as limiting. Researchers and developers offer an invention to meet the need or overcome the physical constraint. Next, the new invention is ‘showcased’ in new movies, then adopted more widely and starts the path toward commercialisation. Often this process causes the retirement of technical methods which are incompatible with the new invention, or are no longer economical. (This development sometimes leads to passionate pleas from traditionalists, who are strongly invested in the old technology and refuse to let it go.) The emergent technology almost always enables and spurs new artistic expression, although it may leave behind some artists and performers who are unable to adjust to the new environment. Formal standards for the new technology follow, allowing mass production and wide distribution. At this stage, new physical constraints are often identified, and the cycle starts anew.

Examples of this process of invention, innovation and diffusion include the arrival of the cinematic technologies of projection, film-base development, sound, colour, widescreen and digital technology, each having an impact on multiple aspects – from how movies are filmed and produced to how they are financed, marketed and distributed. Keys to the success of new cinema technology have been maximisation of on-screen effect whilst minimising investment in technology and infrastructure, and being compatible with existing standards (back-compatibility).

Professor Kam then focused on developments in projection. Projection was one of the main bottlenecks in the early history of cinema, with early solutions not allowing projection of a movie simultaneously to multiple viewers. He discussed Thomas Edison’s kinetoscope, which achieved some popularity. However, the short movies it offered could be viewed by only one person at a time. To accommodate a crowd, Edison built special kinetoscope parlours with multiple devices (the first parlours were established in New York and London in 1894).

A breakthrough in the technology of projection was achieved by Auguste and Louis Lumière, who built on the work of Reynaud to use patented perforated film in a new type of camera/projector. Their cinematographe – a camera, projector and developer in one device – allowed simultaneous viewing of the same movie by many people. An additional advantage of the Lumières’ technology over Edison’s bulky and heavy kinetoscope was the handiness of the cinematographe – it was light and transportable.

In 1895, the first Lumière footage – showing workers leaving the Lumière family factory – was recorded using the cinematographe. Owing to this and many subsequent movies, the Lumières are remembered not just because of their technological inventions, but also due to their achievements as cinema artists. Their short movies were not meant just to be a showcase for new technology, but had structure, design and story line. Unlike most earlier movies, such as the ones showed in kinetoscope parlours, the Lumière movies were carefully staged and directed.
Artistic innovations followed apace — improvements in the way that sequences were shot, how ‘cuts’ were made to ensure a continuous viewer experience, and how viewers were guided to develop inference and interpret the emerging language of cinema. Technological advances made it possible for cinematographers and directors to expand artistic expression and develop a new visual vocabulary of the art. They used this vocabulary to communicate with growing and increasingly-appreciative audiences.

Professor Kam described how ’special effects’ were introduced, citing the work of impresario and magician George Méliès, who exported tricks from his theatre and circus shows to film. Méliès, incidentally, wanted to buy a cinematographe from the Lumière’s father in late 1895, but was refused on the basis that cinema would likely be a short-lived fad, so the Lumière family may as well exploit it while interest remained. This incident is possibly the first (of many) prophesies of the imminent ‘death of cinema.’

Many of the cinematic techniques used today have their roots in the early days of cinema. A notable example is Dziga Vertov’s Man with a Movie Camera (1929), which uses multiple techniques popularised and honed decades later, including double exposure, fast motion, slow motion, freeze frames, jump cuts, split screens, Dutch angles, extreme close-ups, tracking shots, footage played backwards, and stop motion animations.

Cinema continued to develop throughout the 20th Century; sound was one of the most significant areas of progress. Edison was a pioneer in this area as well, but again he was eclipsed — this time by Emile Berliner, whose gramophone used mass-produced discs which were superior to the cylinders used in Edison’s phonograph. Then the technology moved to ‘sound on film.’ In 1926, the first commercial screening took place of a feature film synchronised to a recorded soundtrack; only nine years later, in 1935, 95 per cent of Hollywood’s output had synchronised sound.

The introduction of sound had significant impact on then-existing practices — cinemas had to be able to play sound for one thing. In about a decade (and in spite of the fervent protests of some traditionalists) the new technology put the silent movie to bed. For a period of time, restrictions imposed by the new sound technology had an adverse impact on lighting and shooting angles — buzzing arc lamps had to be replaced by incandescent bulbs, and noisy projectors had to be isolated in bulky projection booths. Tinted and toned movies, the precursors for movies in colour, were discontinued because film development had to take into account the needs of the optical track, and because tinting/toning tended to reduce the quality of sound reproduction. Kam demonstrated how the emergence of sound techniques and the use of mixed silent and talking scenes were employed by film-makers to invent new artistic effects. One example is Hitchcock’s Blackmail (1929), where the director develops an ongoing ‘dialog’ with the new technology of sound along with the deployment of the main narrative of the film. Kam compared the mixing of silent and talking scenes in Blackmail to the mixing of digitally photographed and Super 16-mm photographed scenes in Black Swan (2010). In both cases, the use of multiple technologies becomes part of the artistic fabric of the movie.

Despite cinema’s close relationship and dependence on technology, cinema has been used repeatedly as an agent to caution against technological advances and their consequences. Cautionary movies about technology have been appearing since the early 20th Century, and include the classic Metropolis (1927). Major themes of Metropolis include the alienation of the individual in the modern city and the heartless oppression of workers by technology (with a destructive robot to boot). More recent examples of technophobia in the movies include The Terminator (1984), Blade Runner (1982) and Minority Report (2002).

Cinema and television have, however, been also catalysts for technological invention and development. The ’23rd-Century communicator,’ from the original series of Star Trek, bears a striking resemblance to the present-day mobile phone, while Star Trek: The Next Generation,
offered flat touchscreen computers similar to today’s tablets. Tablet-type computing devices were also shown in 2001: A Space Odyssey (1968), while Fahrenheit 451 (1966) demonstrated an interactive big-screen television.

While some of these – and other developments such as e-paper and facial recognition – are now available, or nearly so, others, such as Harry Potter’s invisibility cloak, time travel, flying cars and human cloning, are more challenging (and in some cases physically impossible) to realise.

Turning briefly to robots (and cyborgs), Professor Kam highlighted them as a popular feature for commenting on technology in films, and for expressing desired specifications of future robots. Many serious developers of robots were inspired to build actual functioning robots in their laboratories by robots that were proposed originally in the movies. A recent study done at the University of Cambridge found that the more films with robots viewers saw, the more positive their attitudes towards robots became. It did not matter if the depicted robots were socially ‘positive’ or ‘negative.’

Professor Kam ended his talk by mentioning a few of the areas he didn’t have time to delve into, such as colour technology, animation, and the development of the cinematic musical score. He also alluded to current and future developments, including 3D, virtual reality and the convergence of movies and games – showing that art and technology are certain to continue to intersect in cinema, now and in the foreseeable future.

Questions

Asked for his thoughts on 3D technology, Professor Kam said he thought there were still technical challenges to make 3D viewing a comfortable experience. Currently, you need devices worn by the audience to make 3D projection work, the technology is expensive, and it is not ‘back compatible’ with existing practices. Kam believes that the technical challenges in this arena are well defined, and it is only a matter of time until we experience less complicated and more ‘natural’ projection technologies. The same observation holds for virtual reality in the movies – at the moment you more or less have to ‘sit in a tank’ to experience it. “We need more technical progress before virtual reality at the movies can be made pleasurable and popular,” he said.

In response to a question about the threats posed by new methods such as 3D to existing technologies, Professor Kam said he didn’t think we should be worried; if the public truly objected to certain technological directions, audiences would not pay to see them and the techniques would vanish. He cited failed attempts to colourise classic black and white films en masse, efforts which were not popular and didn’t last.

Asked which future technologies excited him, Professor Kam said he was interested in haptics, the technology of touch. He foresees a full sensory experience at the movies. The viewer would not just see and hear the movie, but could feel its environment, smell it and have a tactile experience. There is already work underway to make aspects of that objective a reality, he said. He is also excited by more interactive movies – the viewer would become an active player in the movie, rather than a passive watcher.

Another member of the audience raised concerns over the sustainability of modern pictures in a digital age – how stable is digital content, and how long-lasting is it? Kam said that digital technology brought many advantages, changed the economics of production, increased accessibility to the art form, and is likely to win the day. He could understand the feelings of those who believe that shooting in 35mm is the best of all filming options, but believes that these views are similar to those who thought that LP records were the best way to listen to recorded music. He acknowledged that the preservation of digital films is a big challenge,
since digital formats tend to become obsolete every few years – possibly making old digitally-
photographed movies inaccessible. However, he believes that “it’s an early technical flaw and we will overcome it.”

The question of finance was raised. Digital technology makes production cheaper but film-
making is still an expensive business. Professor Kam said that although there had been great strides due to digital technology in production, there are still significant barriers in the areas of financing and distribution. Advertising is still very expensive, although there are ways to exploit different digital platforms and new media to reduce these costs. Similarly, new ways emerge of financing films through internet communication networks, such as crowdfunding. Crowdfunding started on the margins of the industry, but is moving to the mainstream – an early example being the current efforts of Spike Lee to raise funds for a new movie on the Kickstart service.

In response to a question about ‘piracy,’ Kam expressed the hope that the film industry would learn from the mistakes of the music industry, which had tried – and failed – to protect itself from digital technology through a combination of copy-protection technology and legal vigilance. Instead, the way forward is to examine the business model of the ‘pirates’ and co-opt them – in the way that Spotify has done for recorded music and Open Access journals are doing in scholarly publishing.

The final question came from the Chair. Sir John Arbuthnott asked what other areas of technology application have affected cinema. Professor Kam said that many technological advances which spurred progress for film originated elsewhere. For example, he cited imaging techniques invented for healthcare, and military technology – night vision methods and image enhancement on radar screens. There are also examples of cinema technology used for non-cinematic applications. Perhaps the most important of these technologies is Phonofilm. This is an optical sound-on-film system developed by Lee de Forest and Theodore Case in the 1920s. The technique was not commercially successful in film production, but was adopted by Norman Woodland and Bernard Silver, the inventors of the Barcode.