

Computational Photography

Photography Group 5 August 2022



Using Picasa for Photo Animation

Mike Hender for U3A – January 2012



MOVING TO THE MAC

Moving to Apple



Collages using Picasa and Turbo Collage

U3A Digital Imaging 20 July 2012

Technology Changes in Photography

Mike Hender U3A Photography 7 June 2013







Photography Group

Mike Hender



Developments in Artificial Intelligence and Machine Learning in Consumer Photography

Technology Changes in Photography

Mike Hender U3A Photography 16 March 2018





u3a learn, lough, live

Camera Phone Update Photography Group Mike Hender 7th May 2021

u3aleam, laugh, live

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Science and Technology

18 February 2020 Wallace Wormley and Mike Hender



Artificial Intelligence

Hardware and Software together power Computational Photography

Computational imaging techniques enhance or extend the capabilities of digital photography in which the output is an ordinary photograph, but one that could not have been taken by a traditional camera.

Professor Marc Levoy, Stanford (Behind many of the innovations in Google's Pixel cameras)





15Bn transistors 16Tn Operations/Sec

What we'll cover

- Key technology trends
- Their impact on photography
- Why computational photography?
- Examples

Most remarkable (and expensive) computational photographs ever taken and released recently



Caveat

- Experience is Apple iPhone based
- "Other phones are available!"
- Comparable results from: Samsung Galaxy, Google Pixel











* Originally Acorn RISC Machine, later Advanced RISC Machine



Moore's Law depends on better, faster chips being introduced at regular intervals

Oct 2021





March 2022



🖆 M1 Ultra

Nov 2020



ĆМ1



ÉM1 Pro

Oct 2021



Further into the future . . .

Is Moore's law coming to an end?

- Deep physics says 'no'
- Many routes forward . . .
- Books to read:
 - Origin Dan Brown
 - What Technology Wants Kevin Kelly
 - The Information James Gleik



In summary – Moore's Law is a key thread in the story of technology advance

• Devices

Mechanical > Digital > Solid State > Algorithms > Al . . .

• Pictures

Paintings > Monochrome photos > Colour > Digital displays > Virtual Reality . . .

• Changes to industry

Xerox, Kodak, Nikon, Canon, Apple, Facebook . . .

Changes to society

• News gathering, shrinking the world, social media, stolen elections, fake news . . .

Ultimately being enabled by Moore's law

Modern camera trends



Human v Camera 'perception'

Modern cameras Trends

Moore's Law Mechanical to Solid State Atoms to Bits - 'Dematerialisation

Twin track approach

- 1. Overcoming the limits of mechanical engineering
- 2. Squeezing more information out of tiny components











ULTRA WIDE

TELEPHOTO

+ Macro setting

It would be great to have a wider zoom range for those distance shots





Where are we with folding lenses?

- 2013 Nokia Lumia 1020
- 2013 Samsung Galaxy S4
- 2019 Huawei P30 Pro
- 2020 Samsung Galaxy S20
- 2023 Apple?



Huawei P30 Pro

The ultimate example of a folding lens – James Webb telescope

- 25 years in development
- \$10Billion
- Over 1200 scientists, engineers and technicians from 14 countries





Squeezing more information out of tiny components

Everything else has to be done in software

Which brings us to Computational Photography!

Typical modern Workflow – Software everywhere







Smart HDR
















Software everywhere – Deep Neural Networks











Key building blocks

• Lenses

- Machine Learning algorithms
- Processors



Consensus view

Leaders?

- Lenses Samsung, Sony
- Machine Learning Google
- Processors Apple



What effect has all this innovation had on the cameras you and I use today?







July 2022

This will be the last ever Nikon DSLR

The laddering effect

- For many, mirrorless cameras have replaced DSLRs
- For others, smartphones have replaced mirrorless cameras
- So, *indirectly*, smartphones have already begun to replace DSLRs.
- Computational photography may be crude today, but it's going to improve with every generation – it's clearly the future.



And so, it came to pass . . .



You'd have to be seriously into photography to want to carry all this around with you

How would you ever squeeze all this into a phone?



Human v Camera 'Perception'



One clue to the way forward in computational photography is from the way humans process images





Bottom line:

Camera specs?

Do you care any more?



Examples from current technology

- In-camera ML software is getting so good that I use Photoshop less and less
- Dependable automatic sorting and retrieval based on ML – Google rules in this area



Examples from current technology

- 'Live Photos' allows you to choose the frame you want – no more closed eyes
- Video and Photos merge into a continuum – Candid Photography



Recent examples from the Jubilee











Three ML based features

- Portrait lighting
- Macro
- Focus pulling





Portrait Lighting



Portrait Lighting



Portrait Lighting



Google Photos 'post production'













Macro Photos




iPhone Ultrawide Lens

• 13mm F2.4 equivalent

• Focus down to 20mm



Siri

Google Lens



"Strawberry in Soda" by Ashley Lee San Francisco, USA







"Sea Glass" by Guido Cassanelli Buenos Aires, Argentina



"Hidden Gem" by Jirasak Panpiansin Chaiyaphum City, Thailand



"The Cave" by Marco Colletta Taranto, Italy

Hibiscus











iPhone Video

- 4K video recording at 24 fps, 25 fps, 30 fps, or 60 fps
- Dolby Vision HDR up to 4K at 60 fps (and edit video on phone)
- Slow motion Macro 4K at 60 fps
- Slow motion Macro HD at 120fps
- 'Cinematic mode' with shallow depth of field at 1080p at 30 fps.

Macro close up uses Ultra Wide Angle lens







Cinematic Mode



AKA 'Focus Pulling'

Human v Camera 'Perception'



Once we accept that all our photos have artificial, ML-generated aspects to them we start questioning what is real . . .





Deep Nostalgia Photography Group

www.myheritage.com

Geoff Walker: " My mother and her mother outside their home in Woodham Ferrers, Essex"







David Bender









Comparison to original





Creative ML in the Arts



Creative ML in the Arts



https://arstechnica.com/gaming/2022/07/ai-art-is-challengingthe-boundaries-of-curation/

Video Ray Tracing



REFLECTIONS

End