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Sabine K McNeill
21a Goldhurst Terrace
London NW6 3HB
Tel: 0044 20 7328 3701
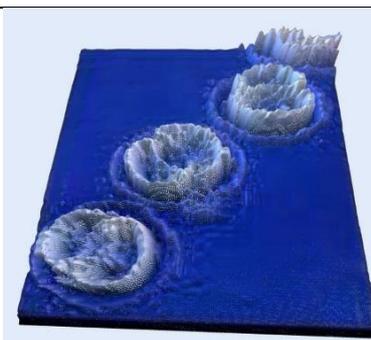sabine.mcneill@3d-metrics.com

Re-Visualising Microscopic Images

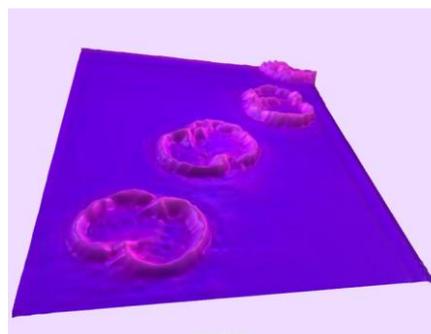## for Seeing with 'Pixel Accuracy' and Measuring in 'Digital Colour Brightness'
Where the Visualisation of Numbers meets the Physics of Light and Colour

1) Summary

Our Smart Knowledge Engine[1] takes images produced by any technology as input and re-visualises them as movable objects in True Colour 3D[2] – with Pixel Accuracy[3]. The first visual impact is rather dramatic and the domain expert may immediately see what's going on, as Prof. Wilson said when he saw stem cells[4] re-visualised:

http://www.smart-knowledge-portals.uk/projects/77

http://www.smart-knowledge-portals.uk/projects/79

[1] http://www.smart-knowledge-portals.uk/

[2] https://smartknowledge.space/true-colour-3d/

[3] https://smartknowledge.space/pixel-accuracy/

[44] http://www.smart-knowledge-portals.uk/projects/77

Besides looking at images with more depth, detail and from varying perspectives, the real value of our unique method lies in the ability to compare images numerically: individually, as series and in parts.

The numerical representation of images is visualised as [Digital Colour Brightness](#)[5] which can now be used as a 'generic yardstick' or 'digital measuring tool' – across different scales and technologies.

The ultimate goal is to optimise the choice of technology for a given scale and application, based on standards provided by reference images from reference specimens.

2) Introduction

Innovative algorithms at the core of our software allow for the manipulation of an image as a movable object in 'virtual 3D'. While this opens our 'visual mind' and our ability to recognise patterns and spot changes, the numerical values of Digital Colour Brightness are quantifications that can now be translated into the qualities that characterise the objects represented in the image.

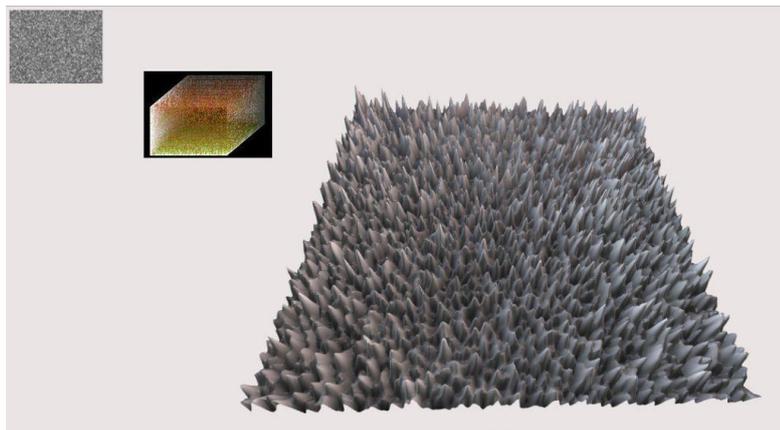The underlying premise is the technology-specific method that translates light and colour into digits.

This leads to [Pythagoras' All is Number](#)[6] as the mathematical principle that models the physical phenomena of light and colour captured in digital images.

3) Methods/Materials

Our [Smart Knowledge Engine](#)[7] enhances our offline prototype that served as proof of concept.

When re-visualising images in online, state-of-the-art capabilities of graphics hard- and software have led to True Colour 3D. This is superior visually, metrically and in terms of user experience.

To analyse [Imaging](#)[8] further, reference images supplied by the National Physical Laboratories NPL demonstrate the added visual value. Below is the progression from the 2D input of a synthetic image to its re-visualisation in [Qualifying 3D](#)[9] and as a [movable object](#)[10] in current True Colour 3D:

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[5] https://smartknowledge.space/digital-colour-brightness/

[6] https://nrich.maths.org/2572

[7] http://www.smart-knowledge-portals.uk/

[8] https://smartknowledge.space/applications/imaging-analysis/

[9] http://3d-metrics.com/gallery/main.php?g2_itemId=5503

[10] http://www.smart-knowledge-portals.uk/projects/48

4) Results & Discussion

The software has reached a stage of development that invites 'domain experts' to decide on research projects that require:

a) dictionary terms with definitions of
   - the qualities of the objects or phenomena represented in series of images
b) boundary conditions setting lower and upper limits for
   - normal and exceptional situations;
c) reference images to be used for
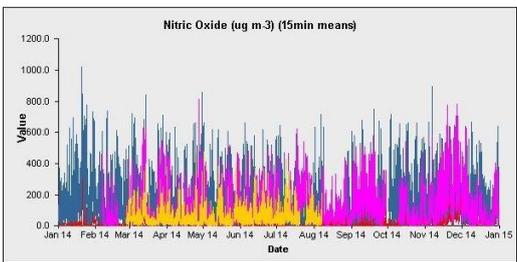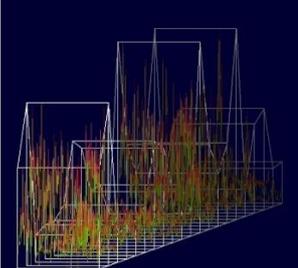   - setting the ratio between regular and acceptable images compared with 'off limits' images.

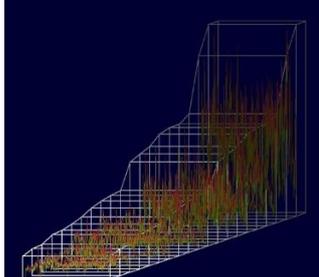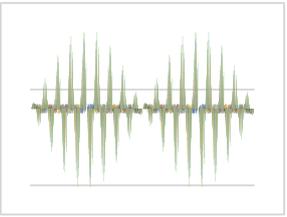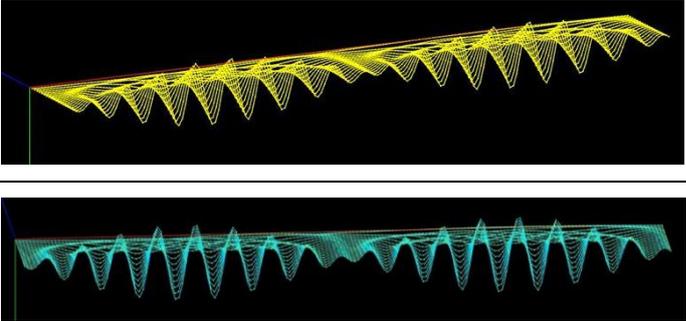This ratio is especially important for Smart Monitoring[11], the automated analysis of real time imaging and thus the control of quality under operator control – whether of car varnishing, drug production or other processes where precision determines quality and efficiency.

5) Conclusion

As a Try before You Buy portal, the Smart Knowledge Engine is currently installed without the necessity to register, and users can upload their own images for re-visualisation.

The functionality to layer multi-dimensional time series[12] needs completing and automated processing capabilities need to be commissioned.

However, mathematical test data with 18 series is currently producing these screenshots in 'virtual 3D':

The offline prototype shows unsorted and sorted layers along a 'visual z-axis' – next to an Excel graph

Our online engine shows data as a movable object in 'Visual 3D' in contrast to the Excel graph

http://www.smart-knowledge-portals.uk/projects/98/showCSV

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[11] https://smartknowledge.space/smart-monitoring/

[12] http://3d-metrics.com/wordpress/software-methods/layering-complex-data