Software lenses
for microscopes,
telescopes
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Accelerating Innovation in Medicine, Physics and Biology

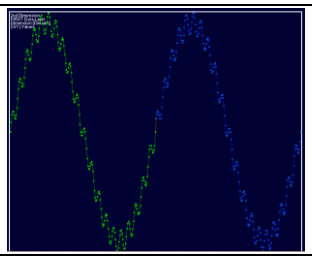
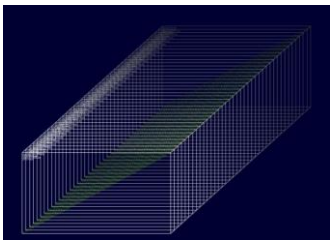
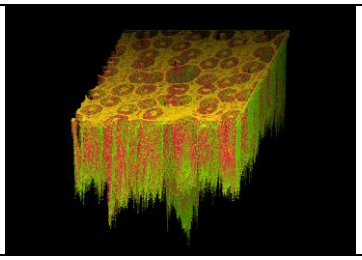
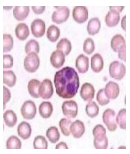
... with 'Software Lenses' as Visual Aids to Identify Hidden Patterns and Quantify Impacts on their Ecosystems

The Annual ENLIGHT Meeting[1]: a Trigger Event

Accelerating Innovation in Medicine[2] was the remarkable overview by Dr Eleanor Blakely[3] of Lawrence Berkeley National Laboratory (LBNL) into the history of collaboration and state of the art: *particle therapy* and *medical imaging* were the brainstorming themes to find the best particle, optimal beam dosage, consistent physical positioning and long term effects of tumour treatments. This covers the challenges of improving diagnosis, therapy and treatment planning.

To tackle these challenges, the 3D metric approach invites the creation of smart knowledge portals[4] – specialising in each particular problem area and collaborating through collating relevant data – so that collaborators can share their insights and interpretations when seeing familiar data and images with new software lenses[5].

'*Software lenses*' are the result of new proprietary mathematical spaces and transformations. Their validity is proven by prototype software that demonstrates 3 software methods[6]:

			
1. Forecasting any Time Series	2. Layering Complex Data	3. Re-visualising Digital Images	
The blue dots are forecasts from the input data without knowing what kind of function it represents. Input can be any time series of multiple or complex applications, with flexibility over chosen time interval. The method produces n-1 forecasts from n input points.	This screenshot shows 40 dimensions or vertical layers. The data points are straight lines illustrating 'visual 3D'. More on Qualifying 3D. This allows a perspective that is specific for each data set and brings with it a whole host of parameters for further numerical analysis.	 The 2D input	These red and white blood cells can be interpreted *visually* by experts and analysed *numerically* by software, as the visualisation of microscopic digitisation.

[1] http://indico.cern.ch/event/313915/
[2] https://cds.cern.ch/journal/CERNBulletin/2014/28/Events/1710344?ln=en
[3] http://www.ncrponline.org/Modals/Blakely-E.html
[4] http://3d-metrics.me/key-features/smart-knowledge-systems/
[5] http://3d-metrics.me/?s=software+lenses
[6] http://3d-metrics.com/wordpress/software-methods

The Benefits of the 3D Metric Approach

In general, the benefits can be described as:

- finding hidden patterns in nature and data
- and quantifying their impact on their ecosystems.

In the practice of particle therapy, domain experts will see more depth and detail when they look at familiar images re-visualised based on their respective *digitisation* of light, colour or sound.

To develop *medical imaging* so that the medical benefits of *particle therapy* can be advanced, imagine your browser with the following menu and user options for you to choose:

- *vocabularies* describing *images* and what they represent
  - produced by any imaging technology with its particular digitisation technique
- you see more visual depth and detail with '*pixel accuracy*'
  - a 'visual z' axis gives you a new perspective
- you are presented with associated *quantifications* accumulated from all images processed
  - the metrics associated with your images are derived from their digitisation
- *multi-dimensional data* relating to your area of interest
  - including a new style of 'layering[7]' data and time series, so that interdependencies can be seen in new kinds of 'data landscapes'.

Since digitisation techniques are specific to every imaging technology, the choice of suitable *reference images* will lead to the *best imaging technology* for the best job.

When investigating biological cells, monitoring medical progress[8] and the effects, positions and dosage of particle beams, it is a matter of *scale* for varying parameters of the software lenses – while the foundation lies in the translation of the *physics* of light, colour or sound into the *digits* that 3d metric software visualises.

Based on the principles of layering time series, the 3d metric re-visualisation of images has thus the following qualities:

- *visual* for the expert eye to see the hidden and invisible;
- *metric* for expert users to agree on selection criteria and their upper and lower boundaries;
- *numerical* for the purpose of identifications and comparisons by machines;
- *digital* to evaluate and compare techniques of digitisation;
- *generic* to cut across scale, technologies and applications.

Embedding Multi-Disciplinary Expertise

From Counting Dimensions to Measuring Qualities

As centres for fundamental research, CERN and LBNL have always been at the forefront of multi-disciplinary collaboration. As a collaborative tool and business model, Software As A Service[9] can now be used to build the foundation for science that is based on data collaboratively accessible through clouds.

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[7] http://3d-metrics.com/wordpress/software-methods/layering-complex-data
[8] http://3d-metrics.com/gallery/main.php?g2_itemId=4907
[9] http://en.wikipedia.org/wiki/Software_as_a_service

In that context, measuring with physical instruments can now be complemented by the human recognition of patterns and the ability of machines to crunch numbers and automate the processing of existing images and data – through the 'eyes' of software lenses.

Dr Blakely referred to biology as the 5th dimension. I would add cybernetics[10] as the foundation for bringing the right infrastructure of *hardware*, *software* and DATA together such that the worldwide research community can benefit.

The real time monitoring of cell processes[11] can possibly contribute best to optimising the challenges of diagnosis, therapy and treatment planning.

Building smart and real time portals for cancer cells, particle beams, tumour treatments and monitoring patient data are tasks worthy of international collaboration that bring together the best of all specialisations.

The ENLIGHT network is the perfect coalition of experts. Data clouds are the new 'marketplace' for adding value through insights and analysis. The web is the perfect carrier for 3d metric *Software Lenses As A Service*. Will funding organisations agree?

The Technique of Generic Numerical MetaData

To illustrate the commercial and scientific potential of the proposed smart portals, it is necessary to sketch the underlying technique of deriving numerical metadata[12]. Normally, metadata consists of verbal descriptors. Similarly, numerical metadata tends to describe number series.

The uniqueness of *deriving* numerical metadata from any digital file is the combination of novel mathematical concepts and feedback between code, data and visualisation.

The most recent specifications describe a *digital toolbox* that produces 18 variables. They are used for the purpose of numerical identification, visual pattern recognition, dynamic user parameters and modifiers of individualised investigations.

From the Birth of the WWW to the Fine Tuning of Software Lenses?

CERN's OpenLab[13] is already a public-private partnership between CERN and ICT companies based on the creation of the web as a collaborative platform.

'Software-aided thinking' has led to the development of *3d metric* concepts and prototypes that allow for another 'quantum leap' of software-based collaboration.

It is hoped that the ENLIGHT network[14] with its fabulous individual and institutional members will form the right seedbed for funding applications that appeal to academic institutions and commercial sponsors alike.

Maybe '*OpenEnlight*' can become the cybernetic platform that will unite the wisdom of our experiences and the knowledge of our expertise with the data from our experiments?

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[10] http://en.wikipedia.org/wiki/Cybernetics
[11] http://3d-metrics.com/gallery/main.php?g2_itemId=1521
[12] http://3dmetrics.me.uk/2013/06/15/numerical-metadata-for-meta-views-of-big-and-very-big-data/
[13] http://openlab.web.cern.ch/
[14] http://enlight.web.cern.ch/about-enlight