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Towards 'Software Standards' at Nanoscale

An Application of '3D Metric' Software Methods for Reference Purposes

1. Introduction

'3d metric' software methods analyse digital images and data using innovative mathematical and metrological concepts in such a way as to extract hitherto unavailable information. They are generic methods that can be applied to a variety of applications using 'engines' specifically built for particular purposes. We plan to offer these methods via web services. We anticipate strong demand, in particular for the image analysis tool. We expect this tool to meet the needs of regulatory bodies who are looking for safety standards regarding the toxicity of artificially produced nanoparticles and nanotubes and the sustainability of materials.

2. A Very Special Opportunity

Nanotechnology makes demands on data about molecular structures that microscopy just cannot satisfy. Observations just cannot be married up with existing theory. The software-based 3d metric approach, which involves 'layering' high-dimensional matrices to visualize multi-dimensional data, offers a methodology to develop standards at nanoscale. The tool, which is independent of scale, can work with data taken from any equipment at any scale and resolution. The data are analysed in a straightforward way that does not rely on theories that may not be meaningful at very small scale. It works for data of any origin and at any level, no matter what the purpose of measuring or the application of natural sciences or the dimensions, length or time scales.

In many disciplines - life sciences or material sciences, pharmaceutical or electronic applications - more and more data is being produced for analysis, comparison and interpretation. The need for new approaches is urgent. For example, the report *International Standards in Nanotechnology* by Nanoposts.com (not online any more) states:
"nanotechnology lacks agreed terminology / definitions, agreed protocols for toxicity testing of nanoparticles, and standardized protocols for evaluating environmental impact of nanoparticles. Furthermore, existing 'methods of test' may not be suitable for nanoscale devices and dimensions, measurement techniques and instruments need to be developed and/or standardized, calibration procedures and certified reference materials (CRMs) are needed for the validation of test instruments at nanoscale. Moreover, international standards are needed to facilitate nanotechnology commercialization and social acceptance of nanotechnologies.

The German standards authority DIN has reported that in Europe, standardization adds approximately 1% of gross domestic product and that the added value generated by standardization is at least as important as the value generated by patents. International Standards provide industries, societies and academia with common languages, methods, practices and products."

3. '3d Metric' Image Analysis as the Road to 'Software Standards'

One of the possible applications of *3dM* software methods is the interpretation of digital image data. Images can represent medical drugs or chemical substances, biological cells or different kinds of materials. But images can also represent 'calibration sets' for measuring instruments. Furthermore, natural and organic materials can be used as 'reference materials'. For further reference purposes, 'reference images' can be produced to establish settings of microscopes and agree on 'reference technologies'.

A wide spectrum of optical and electronic microscopes is used as measuring instruments and 'reference materials' are as important as 'calibration sets' - whether for *Glaxo Smith Kline*, *NPL* or the *Institute of Materials, Minerals and Mining*.

While sustainability for materials is as important as toxicity for medicine, *3dM* software methods allow for assessing both.

4. The Genericness of '3d Metric' Software Engines

But the *3dM* software engines can be applied to yet more. Image analysis is only one of the possible applications. However, the current hype and topicality of nanotechnologies provides as much a market as the need for nanostandards by regulatory bodies. Hence it has been decided that, in terms of marketing, priority needs to be given to using image analysis as the first web application.

By installing *3dM engines* on web servers, web portals for image analysis can be followed by portals for scientific applications as well as business intelligence as examples.

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5. Penetrating the Market of Measuring Instruments and Visualization Software

While metric engines can be embedded as black boxes in a web service, software can also be embedded in chips which can be attached to measuring instruments.

Visualization software attached to microscopes belongs to one type of measuring instrument which can be enhanced by downloadable add-ons or plug-ins. Other instrumentation can be enhanced with '*3dM chips*'.

Suppliers of image data for proving *3dM concepts* have therefore included

- *NPL* for reference images to investigate imaging technologies with a view to establishing a 'reference technology'
- *GSK* to compare images from product analysis
- *Nanosight* to evaluate videos of Brownian motion
- *Thomas Swan* to make use of chemical data and Raman spectroscopes
- *Johnson Matthey* to detect gold particles
- and two German companies selling very different microscopic instrumentation.

All in all, *3dM* engines will allow not only for high value but also high volume markets, since server software can be installed in private companies as well as for public access.

The IP is protected by programming and access depends on prior payment.

6. The Web as a Marketing Tool

It is a most fortuitous commercial opportunity to make use of the web not only for installing and distributing *3dM engines* but also for their marketing and selling.

Users don't buy software, but the right to process a specified amount of data files – always with the latest software version available, linking one application area to another.

The international standards development organizations (SDOs) who have moved to respond to the call for a diverse array of standards from industry, academia and government, ought to be among the first users as 'strategic co-developers'.

Marketing to end users will be accompanied by marketing to companies of visualization software. They will want to use add-ons or plug-ins in the same way as Flash plug-ins are used for visualizing animation on web pages.

Furthermore, companies that produce measuring instrumentation are also marketing targets. They include producers of optical and electronic microscopes but also other instruments.

7. Measuring Commercial Strength

When considering market size, return over investment or profitability over time, it is important to note:

- a. www.3d-metrics-IMAGES.net will be the first portal to allow access to stakeholders across instrument users and producers and anybody interested in process analytical technology, quality control, optimisation and quantification based on digital images.
- b. www.3d-metrics-DATA.net will be the second service to analyse and interpret any complex system of many dimensions and parameters – whether originating from business intelligence or climate data, automated or manual measurements, labs-on-chip or other high throughput mechanisms
- c. Page 5 of the *International Standards in Nanotechnology* report says:
“Nanotechnology-related standards must be internationally recognized and adopted; otherwise market access will be limited and commercialization will be slowed.”
- d. I believe that DEFRA and BIS are the best possible combination to convene the gathering of information and knowledge necessary to implement this international adoption process. But it does require the smart implementation of clever technologies. *3dM Web Services* thus offer the perfect tool for perfect collaboration.

Sabine McNeill - 18-Jul-12