

https://mensuel.framapad.org/p/quarep-limi_wg10_1st_meeting-9i7r?lang=en

QUAREP-LiMi WG10 Image Quality (IQ) - 1st meeting

2020/08/06

Not recorded (unfortunately).

Attendees : 11/18

Steve Bagley (Manchester, UK), Gert-Jan Bakker (Nijmegen, NL), Ryma Bebane (Paris, F), Konstantin Birngruber (Gräfelfing, D), Ulrike Boehm (Ashburn, VA, USA), Thomas Guilbert (Paris, F), Roland Nitschke (Freiburg, D), Perrine Paul-Gilloteaux (Nantes, F), Sandra Ritz (Mainz, D), Olaf Selchow (Gera, D), Martin Stöckl (Konstanz, D)

Off line contributors : +3

Peter Bajcsy (Gaithersburg, MD, USA), Nathalie Gaudreault (Seattle, WA, USA), Gerhard Holst (Kelheim, D)

Suggested schedule :

- Welcome intro

- Who are we ?

Everyone should explain very briefly what IQ is for her/him according to personal background (30min)

The WG is very complementary with data scientists, core-facility managers, globally image specialists. Many definitions came out. Transparency in acquisition workflow, repeatability, trustful metadata are what came up most often.

IQ is related to the question that experiment tries to answer.

IQ is related to experiment technique itself.

IQ is linked to the way the analysis is planned.

Ulrike summed up it all noticing IQ is directly linked to the global experiment design.

- Global presentation Thomas + Ryma (10min)

An heuristic map has been drawn by Thomas and is going to be available to all in order to try to set up all the key words IQ refers to. Ideas can come from there. Everyone is incited to modify it in her/his own way. A *.json file will be sent soon by Thomas.

Ryma presents her debut work on image sorting/ranking based on an algorithm from Image Quality Ranking Methods article [Koho et al. 2016].

- Should Metadata be involve in IQ criteria ? (10min)

At least 5 members of IQ WG10 are also involved in WG7 Metadata. Everyone agreed on involving many metadata aspects in IQ evaluation.

- What about image improvement based technics, such as AiryScan, Thunder and so on? (10min)

Steve notes that we can not completely let down these aspects of imaging systems. We should at least comment on it, for example saying that these kind of technics remap the data. Users must be aware of that. Here, Sandra introduces the RAW data notion, that could be put next to « processed data ». Roland points out that « RAW data » is a very relative notion in microscopy. However, we all agreed on a RAW data definition as a non processed image.

- IQ in image database (10min)

Image database is a very powerful tool. For this topic, Thomas point out the fact that the import process of an image in a database can involve processing, metadata tag annotations, metadata check, which could be very usefull to IQ evaluation process.

Peter notes that in theory, the WG could define the requirements for depositing images to a database if the measurement task is well defined and therefore IQ metrics can be computed for each image.

- Microscopy techniques dependency : various sensors imply various noises (and various experiment philosophies), that imply various quality indexes. How to deal with this levels of complexity ? (possibly endless)

Globaly, the technical aspect of an experiment is essential. But so is the question the experimenter wants to elucidate, and so is the way image resulting is going to be processed.

Then, trying to be as exhaustive as possible, we have to define many quantitative criteria related to image processing that can be done (SNR, dynamic, spacial frequencies...). We also have to list all processes that can be done for a given experiment (colocalization, segmentation, ratiometric imaging...). These terms, well define and then easy to stick on an experiment, could become tags of an image, and then could lead to defined criteria to define a part of the IQ. Gert-Jan define this process as a dashboard. It fits well with Martin view, saying that we should have *a priori* requirements technique by technique. This idea fits also with the fact that an image passing through an IQ process must be quantifiable (Thomas).

To complete that, Perrine says that we need to define a list of criteria to be assessed, without qualifying it as bad or good, such as : contrast indicator is... ; SNR is... ; dynamic range is... ; saturation level is... ; and then try to define a range for each criteria, for each technics. This way we could create our own summary measurement needed.

Steve warns the group of the risk that there could be to tend towards a comparison between systems performances. Roland replies that the WG aim is to measure output of science experiment. At some level, microscope producers might not like the work we plan to do, mainly because of transparency in acquisition workflow we would like to reach.

Thomas suggests that each ISO WG of QUAREP-LiMi initiative could contribute to WG10 giving criterion or criteria with ranges, for a given technique, which would have the advantage of qualifying all the ISO sensitive parts of a microscope, upstream the notion of IQ. This set of criteria could take the form of a star in the idea Sandra set up of a 10 stars ranking method.

Reference samples : Many of us point the usefulness that this kind of samples could have to determine specific standards. Roland notes that idealy, artificial samples well designed, well known, would be the key to IQ evaluation.

- What shape results of this WG should take ? (10min)

Guideline, standards, white paper with recommandation that would become an output into some standardization effort (Peter).

Automatic data process from intrinsec image pixels values and metadata could leads to a 10 stars ranking method (Sandra). Many stars may be important for one technic or another one, but not necessarily all of them.

On Ulrike, Perrine, Roland and Thomas proposal, the whole group agreed on 3 missions to implement

to start to dig correctly IQ :

1. Set up a common spreadsheet everyone can access in order to list all image processing criteria which we personally think are linked with IQ. Commentaries should be added to explain why.
2. On our own side, everyone should write and describe microscopy technics she/he use and describe what is important to correctly achieve / process them.
3. If a 10 stars ranking method is set up, what would be for you the criteria on each of these stars ? Note that each individual star can have color ranking depending on the quality of the criterion.

- Elect / select speaker and vice-speaker for the group. (10min)

Speaker : Thomas GUILBERT

Vice-Speaker : Ulrike BOEHM

=====

Additional contributions by email :

Gerhard Holst (Kelheim, D):

Everyone should explain very briefly what IQ is for her/him according to personal background

I am Gerhard Holst, PhD, head of research dpt. of PCO AG, a company who develops and manufactures scientific cameras (www.pco.de). Further I am since the beginning member of the EMVA1288 working group, which created and released and continuously tries to improve the EMVA1288 quality standard (EMVA Standard 1288 - Standard for Characterization of Image Sensors and Cameras) (<https://www.emva.org/standards-technology/emva-1288/>) from the European Machine Vision Association, which is as well accepted from the AIA (North America), JIIA (Japan), VDMA (Germany) and CMVU (China). We do the quality control of our cameras compliant to EMVA1288 (if possible). Therefore I have some experience with the development of standards and the evaluation of area based image sensors and their characterization.

Further I am responsible for projects and questions, if our cameras (CCD, sCMOS, CMOS) are applied in life science especially in microscope systems. I am applying and conducting various research projects and for example our part of the development (together with BAE Fairchild and Andor) of the sCMOS technology was one of my projects. At PCO I am also responsible for writing knowledgebase articles around cameras (https://www.pco.de/fileadmin/fileadmin/user_upload/pco-product_sheets/PCO_scmos_ebook.pdf) and tutorials

(https://www.pco.de/fileadmin/user_upload/pco-knowledge_base/20140412_FOM_CameraTutorial_PCO_fin_pdf.pdf).

Microscopy techniques dependency : various sensors imply various noises (and various philosophies), that imply various quality indexes. How to deal with this levels of complexity ?

We should separate between different image detection or imaging methods: Area based image sensors, line scan based image sensors and point detectors (and relatives). Maybe area and linescan image sensor based systems (cameras) can be grouped together, but point detectors are definitively different.

Should Metadata be involve in IQ criteria ?

In my opinion we don't need meta-data, only as setpoint / operational point information. All criteria which we will suggest and which should be measured, require the notification of all corresponding setpoints, otherwise it cannot be reproduced or repeated. Please have a look to the 2nd page of the attached test certificate of one of our cameras (page 2).

What about image improvement based technics, such as AiryScan, Thunder and so on?

All „image improvement techniques“ which involve non-traceable image processing should be excluded, because I don't see how they can be quantified. I mean, if it can not be quantified, in my opinion it is useless for our initiative, because I don't see how it can be compared.

IQ in image database

Are you referring to ground-truth data, or image storage formats? We use certainly all pure image storage formats, still the best in our opinion is TIFF and relatives, but we support dicom as well.

What shape results of this WG should take ?

If possible, definition of methods and procedures how to describe, measure and evaluate image quality for different microscope methods in combination with different detectors.

Nathalie Gaudreault (Seattle, WA, USA) :

Everyone should explain very briefly what IQ is for her/him according to personal background

Image Quality for me is more than just SNR or CNR. I operate/manage an automated 3D Image pipeline of live cells in high resolution using multiple spinning disks. We perform Image quality control which include biological sample info (z-stack completeness top/bottom of cell included, absence of debris or dead cells, ect...), Fluorescence information (Intensity of 4 channels), camera alignment of images from two cameras, and absence of missing plane or disordered planes. We look for deviation from trend and constant STDEV.

Microscopy techniques dependency : various sensors imply various noises (and various philosophies), that imply various quality indexes. How to deal with this levels of complexity ?

Record trend of your system and experiment and look for deviation from trend. Alternatives are specs of your sensor.

Should Metadata be involve in IQ criteria ?

Yes and with the image file, not a separate csv or database.

What about image improvement based technics, such as AiryScan, Thunder and so on?

IQ should still be assessed but requires special criteria (advanced model or advanced protocol)

IQ in image database

Metrics used to assess IQ should be logged in a database to study trend over time and flag specific reason why IQ failed x, y, z criteria (based on application of downstream analysis).

What shape results of this WG should take ?

Recommendation on how to assess and measure IQ, and perhaps report on IQ (for publication/reproducibility)

Peter Bajcsy (Gaithersburg, MD, USA)

Everyone should explain very briefly what IQ is for her/him according to personal background

Image quality is of my interest with respect to a measurement task. Depending on the measurement task, the quality metrics must be defined accordingly.

Microscopy techniques dependency : various sensors imply various noises (and various philosophies), that imply various quality indexes. How to deal with this levels of complexity ?

I am very interested in understanding IQ for novel imaging instruments, such as Fourier Ptychography based imaging, advanced fluorescent imaging, etc.

Should Metadata be involve in IQ criteria ?

Metadata is always important. The WG10 could specify which parameters are important for evaluating IQ metrics.

What about image improvement based technics, such as AiryScan, Thunder and so on?

The WG 10 could provide a “recommended” set of techniques but they should be completely transparent (i.e., proprietary techniques should not become a standard).

IQ in image database

I am not sure about this question. In theory, the WG could define the requirements for depositing images to a database if the measurement task is well defined and therefore IQ metrics can be computed for each image.

What shape results of this WG should take ?

The WG 10 could generate a white paper with recommendations that would become an input into some standardization effort.