Whole Slide Imaging
15 January 2015

The meeting was called to order at 10:00 am (EST) by Craig Revie, chair, with the following attendees:

Craig Revie
Debbie Orf
Glenn Davis
John Sweeney
Dave Wyble
Elizabeth Krupinski
Po-Chieh Hung
James Chang
Tom Lianza
Masahiro Yamaguchi
Jeremie Pescatore
Efrain Morales
William Li
Allen Olson
Phil Green
Prarthana Shrestha
John Thomas
Michael Flynn
Darren Treanor
Tom Kimpe
Flora Lum
Wei-Chung Cheng
Yves Vander Haeghen

Following a sound check, Mr Revie introduced the agenda as follows:

Agenda

1. Future meetings
2. Uniformity / smoothness of LUT-based profiles (Glenn Davis)
3. Sierra Calibration Assessment Slide Measurements
   - GE Omnyx measurements (Dave Wyble)
   - Datacolor measurements (Hong Wei)
4. Round-robin status update (Craig Revie)

- Alternative assessment method (in light of poor support for DICOM)

5. Next steps for colour calibration assessment
6. CIE Reportership on 'Common colour appearance' (Craig Revie)

1. Future meetings

Mr Revie listed forthcoming meetings of MIWG [see attached]. The next meeting was a face-to-face meeting of the whole group in March in Kuurne, Belgium.

2. Uniformity / smoothness of LUT-based profiles

Dr Glenn Davis presented some analysis of uniformity and smoothness in LUT-based ICC profiles [see attached]. He proposed a second derivative based metric, ranking bad ramps, and presenting them for visual evaluation. He noted the need to avoid including ramps in out-of-gamut colours in the evaluation.

Dr Allan Olsen reported that he had also found problems in slide data with non-smoothness. Mr Revie asked people to suggest ways of evaluating smoothness and tools for doing so.

3. Sierra Calibration Assessment Slide Measurements

The meeting reviewed measurements of the Sierra calibration assessment slide by participating vendors:

3.1 - GE Omnyx measurements

Dr Dave Wyble described the measurement setup used at GE Omnyx and the results of the test [see attached]. A Konica-Minolta telespectroradiometer was used in conjunction with a sphere and xy stage. The measurement aperture was overfilled, and the measurements were relative to a blank slide, using an open port measurement as a reference. He compared the GE Omnyx results with FFEI measurements relative to white, and taking calibration differences into account there seemed to be good agreement.

Craig Revie stated that FFEI also use an open port measurement, and the data should agree if scaled similarly. He asked Dr Wyble to send him data for comparison. Dr Po-Chieh Hung noted that the measurement geometry should ideally match the geometry of the digital microscope.

3.2 Datacolor measurements

Dr Hong Wei described the measurement setup and user interface at Datacolor [see attached]. Results have been accepted for publication in Color Research & Application.

Transmittance measurements had been made relative to the first sample, and there had been good agreement on all colours except two. Others present reported large differences with the same two patches, and Dr Olsen suggested a need to check if the slide is changing. Mr Revie noted that there was an issue with Eosin stabilisation which influenced these two patches due to the time of immersion of the biopolymer in the stain, and this has been improved for future versions of the slide.

4. Round-robin status update

Craig Revie gave an update on the Sierra calibration assessment slide round-robin [see attached], which was behind schedule but progress was being made. New slides have been made and distributed. Mr Revie showed the assessment method. Consideration had been given to which illuminant to use in computation of colorimetric values from spectral transmittance; currently D50 is being used, but there may be alternatives. He showed that some of the stains are outside the gamut of both sRGB and Adobe RGB (1998).

Although it had originally been agreed to use DICOM as a common file format for the round-robin, not all vendors were able to generate DICOM images from the data, and another solution was needed.

Scanned images can be compared visually in Adobe Photoshop, but this is limited by the display gamut. Mr Revie noted that some scanners converted the data to a scanner profile, while others used a standard encoding profile such as sRGB. The assessment uses the associated profile to interpret the slide colorimetry.

Mr Revie showed a 3D plot of the inter-vendor differences, which he preferred as a method of comparing results. Vendor names and devices were anonymized. CIELAB values had been computed in Matlab, based on an average of the pixels in a patch. The plot showed significant chroma compression, especially with certain devices. It was also noted that differences in flare during measurement or viewing lead to differences in slide contrast.

Mr Revie showed a summary of feedback on the calibration assessment slide, which included points on the slide layout, manufacturing and measurement.

5. Next steps for colour calibration assessment

Mr Revie proposed a schedule for publication of the results [see attached], with the goal of concluding by mid-2015.

Dr Olsen noted that there appeared to be a 5-10% variation in the measurements, depending on who is measuring. He referred to a previous presentation by Dr Davies on the effect of variation in numerical aperture, which could be 2 in CIELAB ΔE^*_{ab} over the aperture range.

Dr Davis requested more documentation on patch formulation. Mr Revie agreed to provide this; FFEI had done extensive testing on the manufacture and their goal was to achieve good agreement with actual pathology slides.

6. CIE Reportership on 'Common colour appearance'

Mr Revie reported that he had been appointed Reporter to CIE Division 8 on 'common colour appearance'. He introduced the topic and the terms of reference of the Reportership [see attached] and noted its possible relevance to medical imaging, such as looking at a digital slide on a display. He invited participation from the group.

The meeting closed at 11:00 EST.

A complete recording of the meeting is available at http://www.npes.org/Portals/0/standards/2015-01-15%2010.02%20MIWG%20Web%20Conference.wmv

Action items

MIWG-15-01 Forward slide measurement data to Mr Revie (Wyble)
MIWG-15-02 Provide documentation on formulation of Sierra calibration assessment slides (Revie)

International Color Consortium

ICC Medical Imaging Working Group

Whole Slide Imaging

15th January 2015

MIWG Agenda (WSI), 15th January 2015

- Future meetings
- Uniformity / smoothness of LUT-based profiles — Glenn Davis
- Sierra Calibration Assessment Slide Measurements
  - GE Omnyx measurements — Dave Wyble
  - Datacolor measurements — Hong Wei
- Round-robin status update — Craig Revie
  - Alternative assessment method (in light of poor support for DICOM)
- Next steps for colour calibration assessment — Discussion
- CIE Reportership on 'Common colour appearance‘ — Craig Revie

Future meetings

Date	Location	Topic
15 Jan 2015	Teleconference	Whole slide imaging
19 Feb 2015	Teleconference	Opthalmology
2-4 Mar 2015	Kuurne, Belgium	Full WG meeting
9 Apr 2015	Teleconference	Medical photography
21 May 2015	Teleconference	Multi spectral imaging (to be confirmed)
8-10 Jun 2015	Tokyo	Full WG meeting

http://www.color.org/groups/medical/medical_imaging_wg.xalter

Kuurne, Belgium, 2-4 March

- Wednesday 4th March will be **Medical Imaging Day**
  - Guests are welcome but must register

- Registration
  - ICC Members: http://www.color.org/membersonly/meetings/meeting-registration.xalter
  - Non-members: http://www.color.org/icc-meeting-registration.xalter
- Meeting Location
  - Barco Kuurne, Noordlaan 5 – 8520 Kuurne, Belgium
- Hotel Messeyne
  - http://www.hotelmesseyne.be/nl/hotel-messeyne
  - Single room: 111.85 euro + tax, Double room: 125 euro + tax
  - Email: hotel@messeyne.com and reference “Barco 1-4 March”

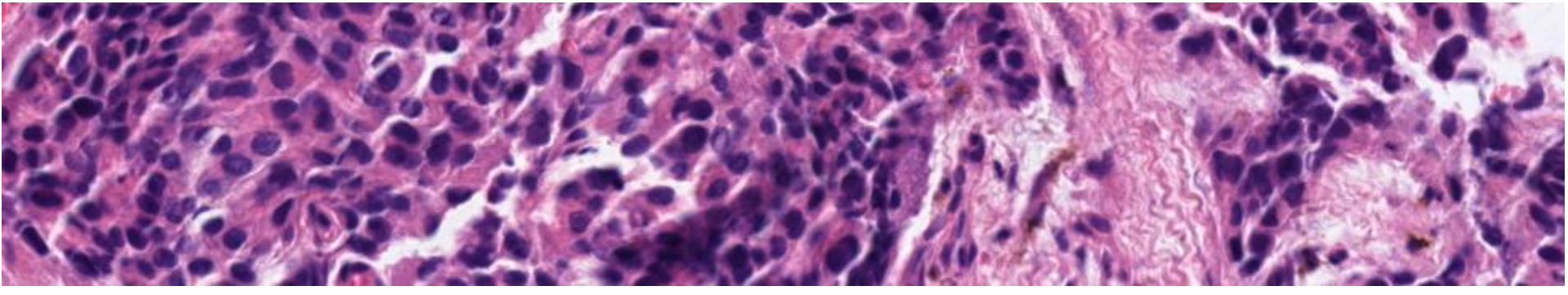
Glenn Davis
Dave Wyble
Hong Wei

Uniformity / Smoothness of LUT-based Profiles

Glenn Davis

Medical imaging teleconference -- (Whole Slide Imaging)

15 Jan 2015



The Uniformity / Smoothness Issue

"Note that lower delta E values are not always a better measure of how good a profile is. The aim of a profile is to model the underlying characteristics of a device, not to slavishly reproduce the sampled data point values. Sampled data point values contain device variation and instrument reading inaccuracies, and a good profiler will try and filter out this noise, resulting in some deliberate differences between the profile and the sample points used to create it." - Graeme Gill
[http://www.argyllcms.com/doc/profcheck.html]

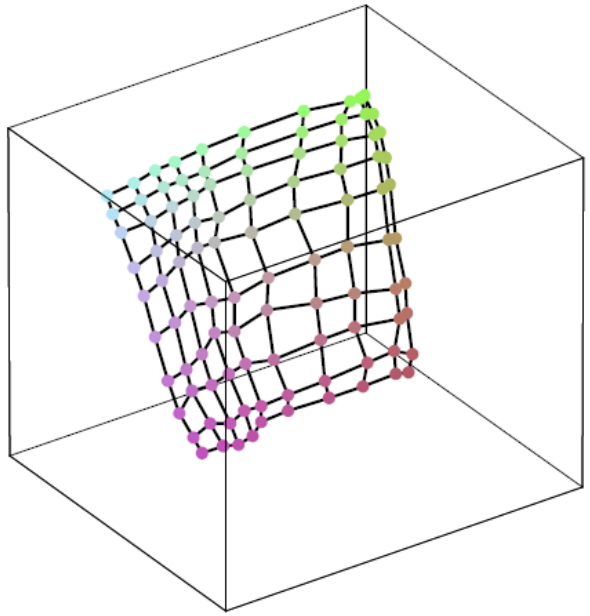
Avoid high variance and overfitting - in the bias-variance tradeoff.

Scope of Issue

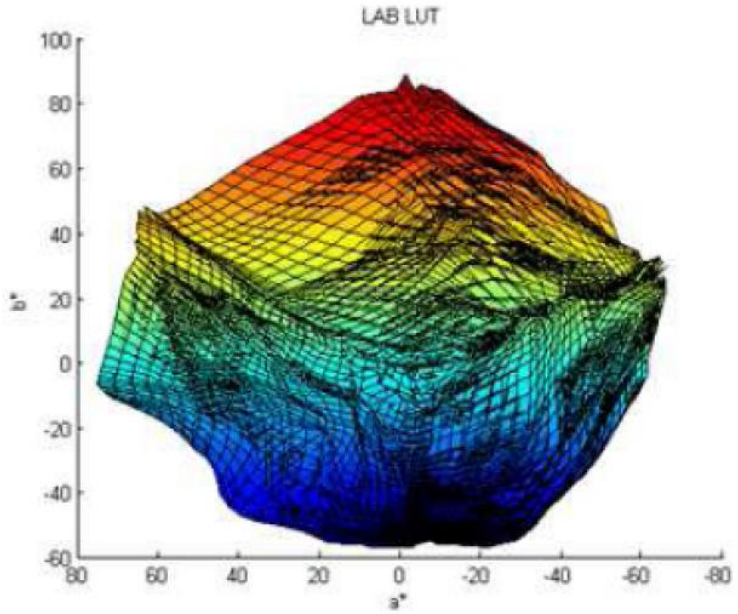
Scanner profiles that use a 3D LUT (not just histology slide scanners)

Scanner profiles that use a matrix-shaper are fairly immune to this issue.

Illustrations of Bad LUTs



Kinks and slope variations, in a planar slice of a LUT, from [4]

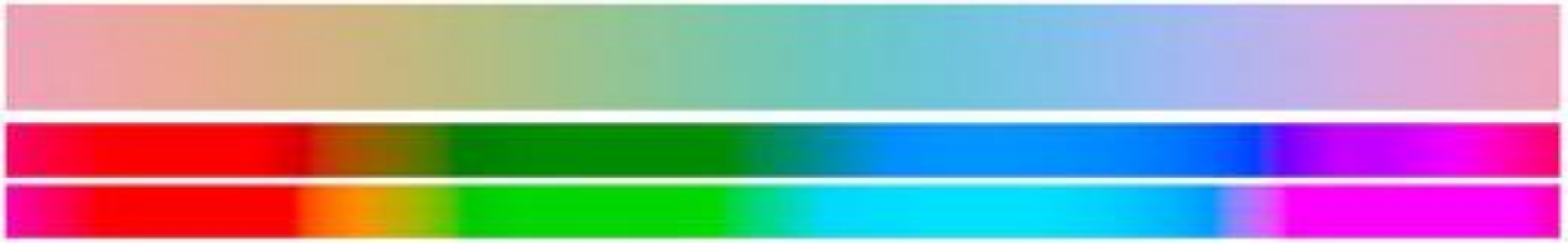


Kinks and slope variations, in a printer profile LUT, from [1]

Diagnostics

Numerical: Second Derivative metric, see [3]

Visual: Color Ramps, see [2] and [4]



these 3 ramps are from [4]

Uniformity Diagnostic Software Idea

1) compute the 2nd derivative of *all* the "ramps" in the LUT in various coordinate directions

2) rank the "bad ramps" in descending order

3) make a simple report showing the "bad ramps" in color form, for visual evaluation

Argyll CMS has programs `iccgamut` and `viewgam` for 3D visualization, but I have not tried them.

References

[1] Aristova, Anna, Zhaohui Wang, Jon Yngve Hardeberg. **Evaluating the smoothness of color transformations**. Proc. SPIE 7866, Color Imaging XVI: Displaying, Processing, Hardcopy, and Applications, (25 January 2011).

[2] Falkenstern, Kristyn, Nicolas Bonnier, Hans Brettel, Marius Pedersen, and Francoise Vienot. **Using Image Quality Metrics to Evaluate an ICC Printer Profile.** Color and Imaging Conference, 18th Color and Imaging Conference Final Program and Proceedings, pp. 244-249(6). 2010.

[3] Green, Phil. **A smoothness metric for colour transforms**. Color Imaging XIII: Processing, Hardcopy, and Applications. SPIE-IS&T, 2008.

[4] Olson, Thor. **Smooth Ramps: Walking the Straight and Narrow Path through Color Space**. Seventh Color Imaging Conference: Color Science, Systems and Applications. Scottsdale, Arizona; November 1999; p. 57-64.

Round Robin Transmittance Results

David R Wyble

ICC Medical Imaging Working Group
Whole Slide Imaging Teleconference
January 15, 2015

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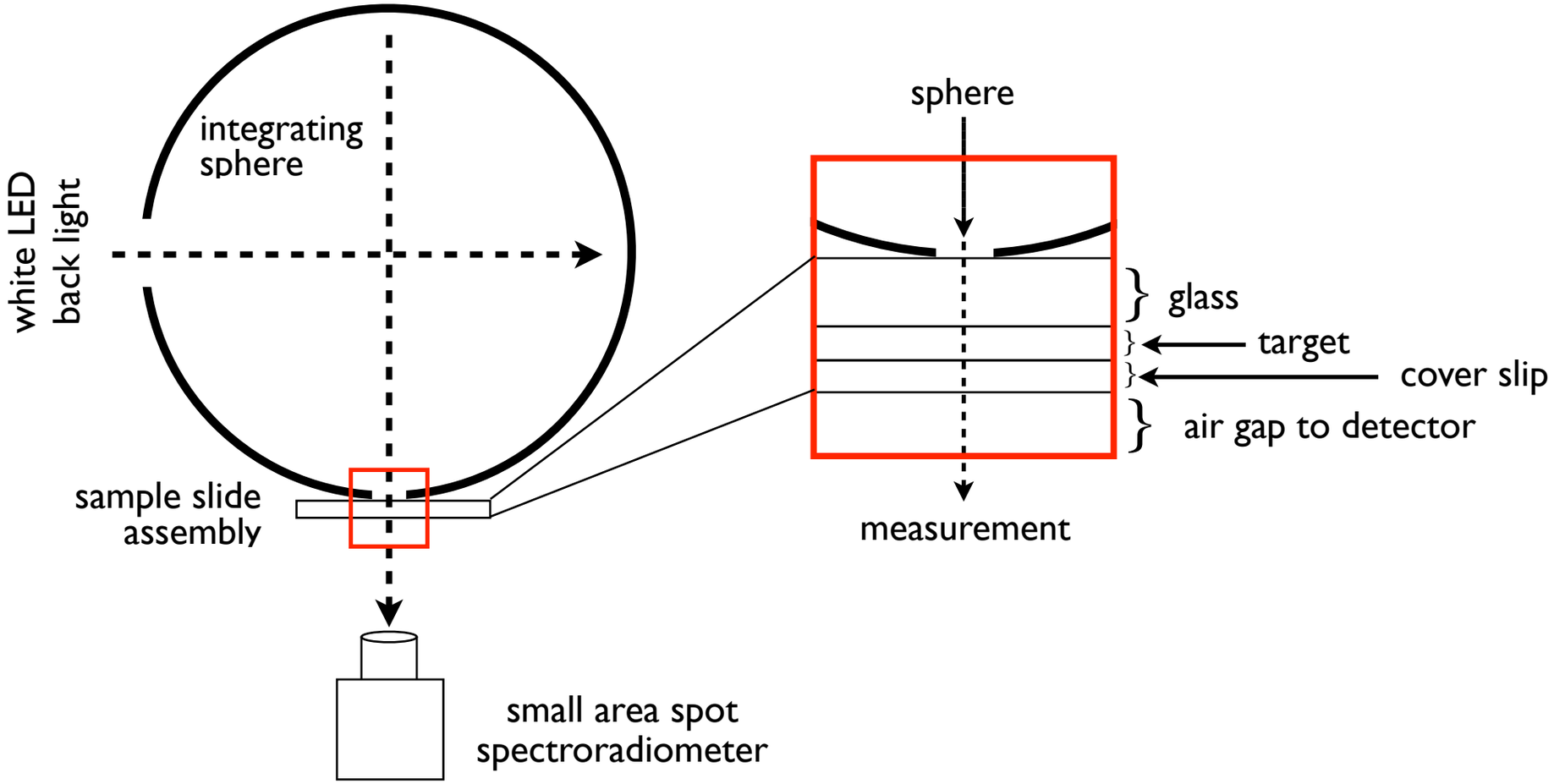
Geometry Overview "d:0°"



ASTM E1348-11: "*Standard Test Method for Transmittance and Color by Spectrophotometry Using Hemispherical Geometry*"

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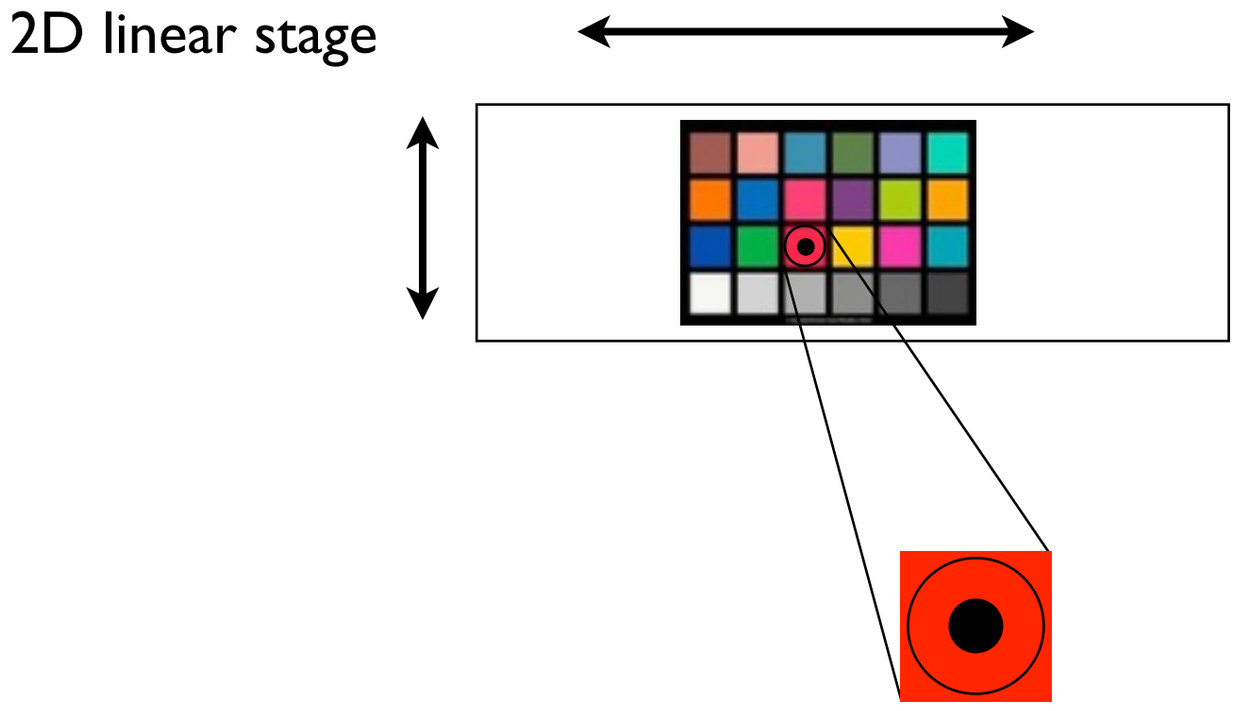
Sample Area Dimensions



red = sample square (4.25mm)
circle = sphere port (3mm)
solid dot = measurement zone (1mm)

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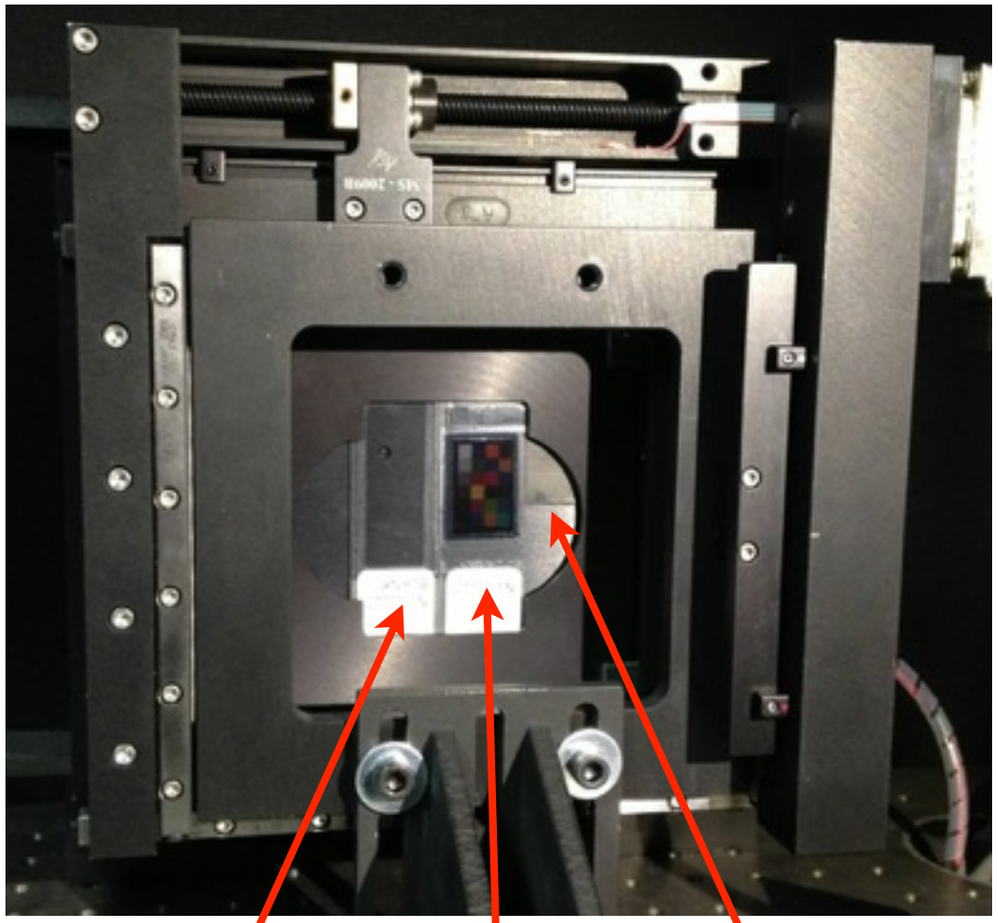
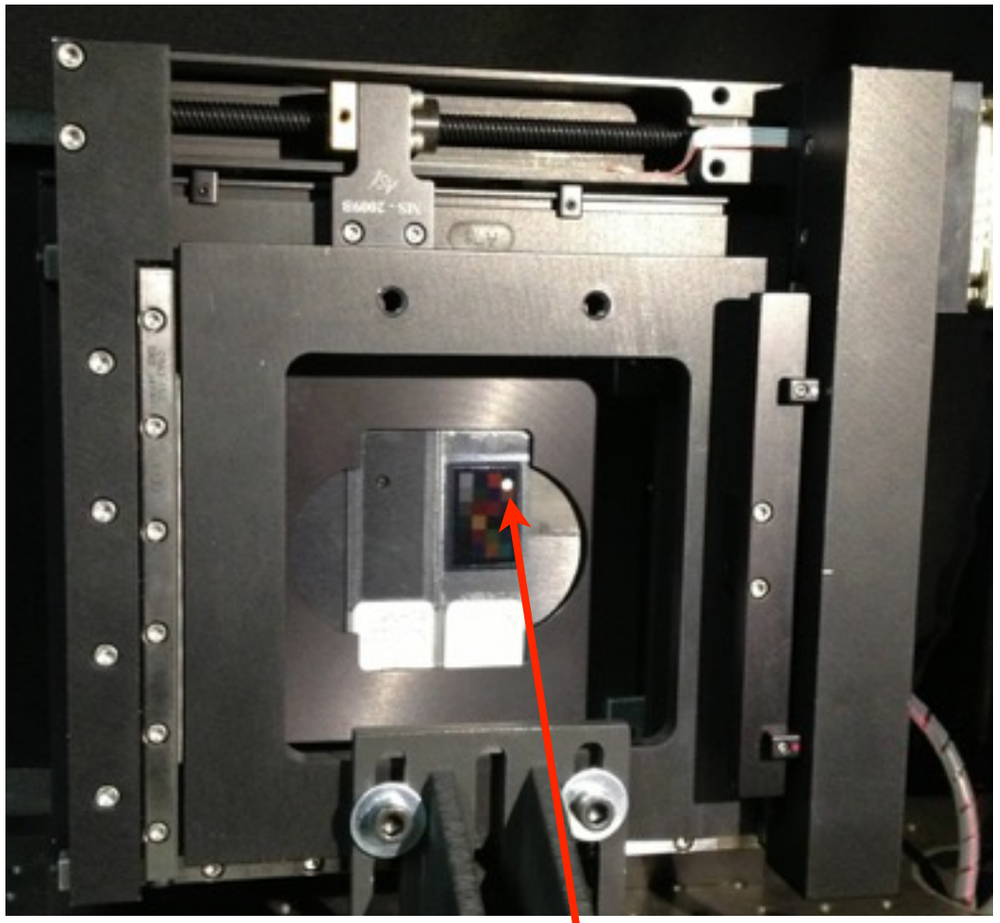


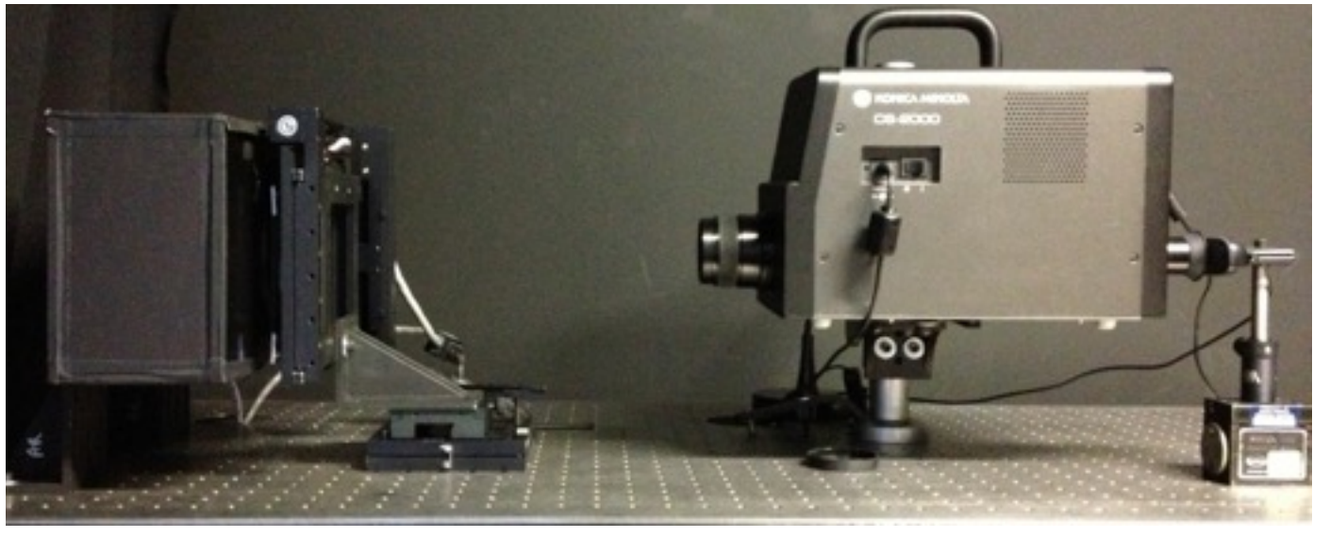
blank slide

color slide

“open port” area



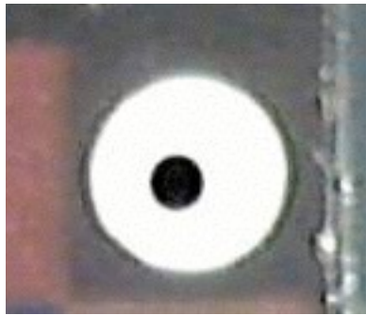
sphere port (LED on)



sphere xy stage

radiometer

camera



camera records every measurement location

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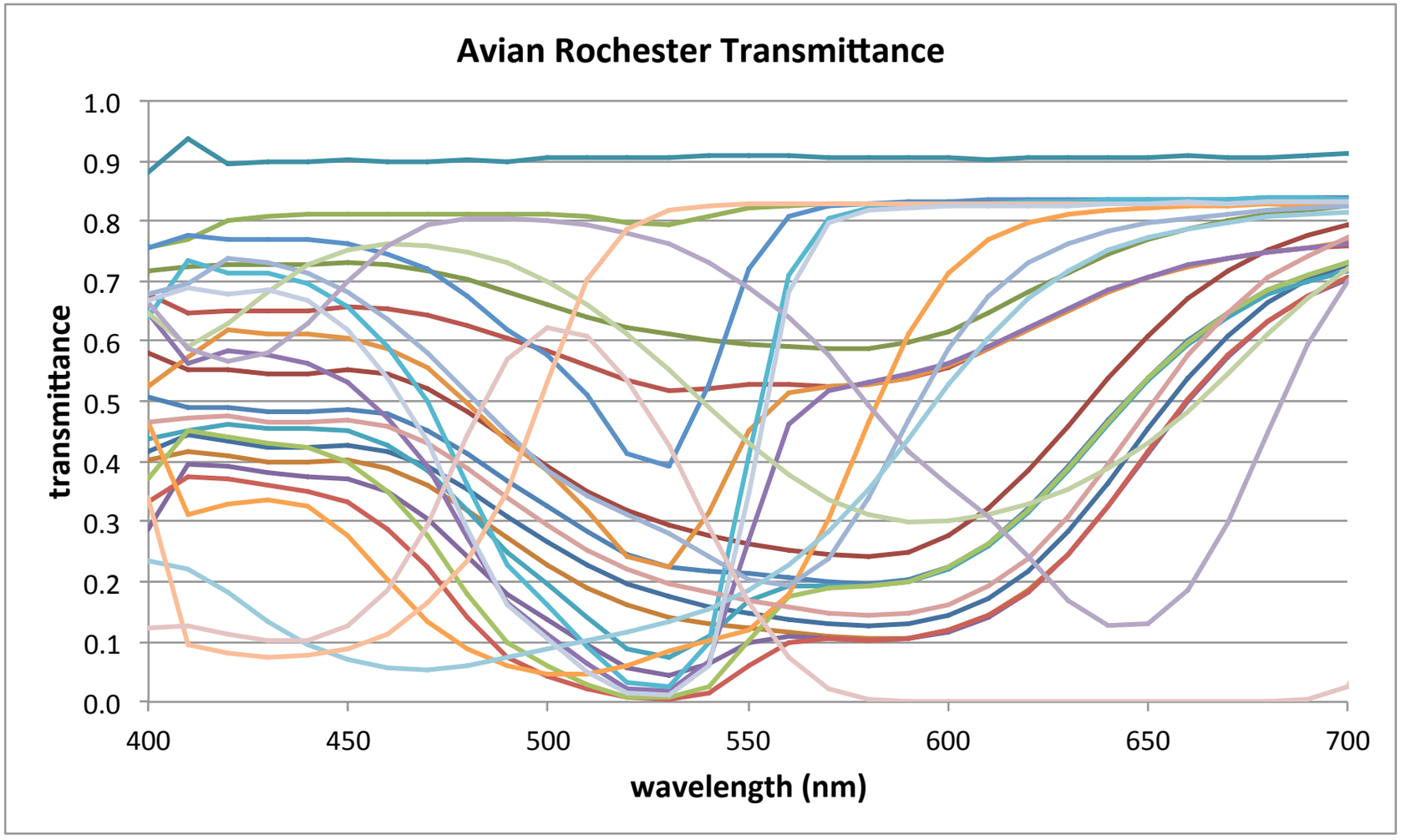
Transmittance Results



From Slide 2014.d.0002
Calibration absolute (to open port)

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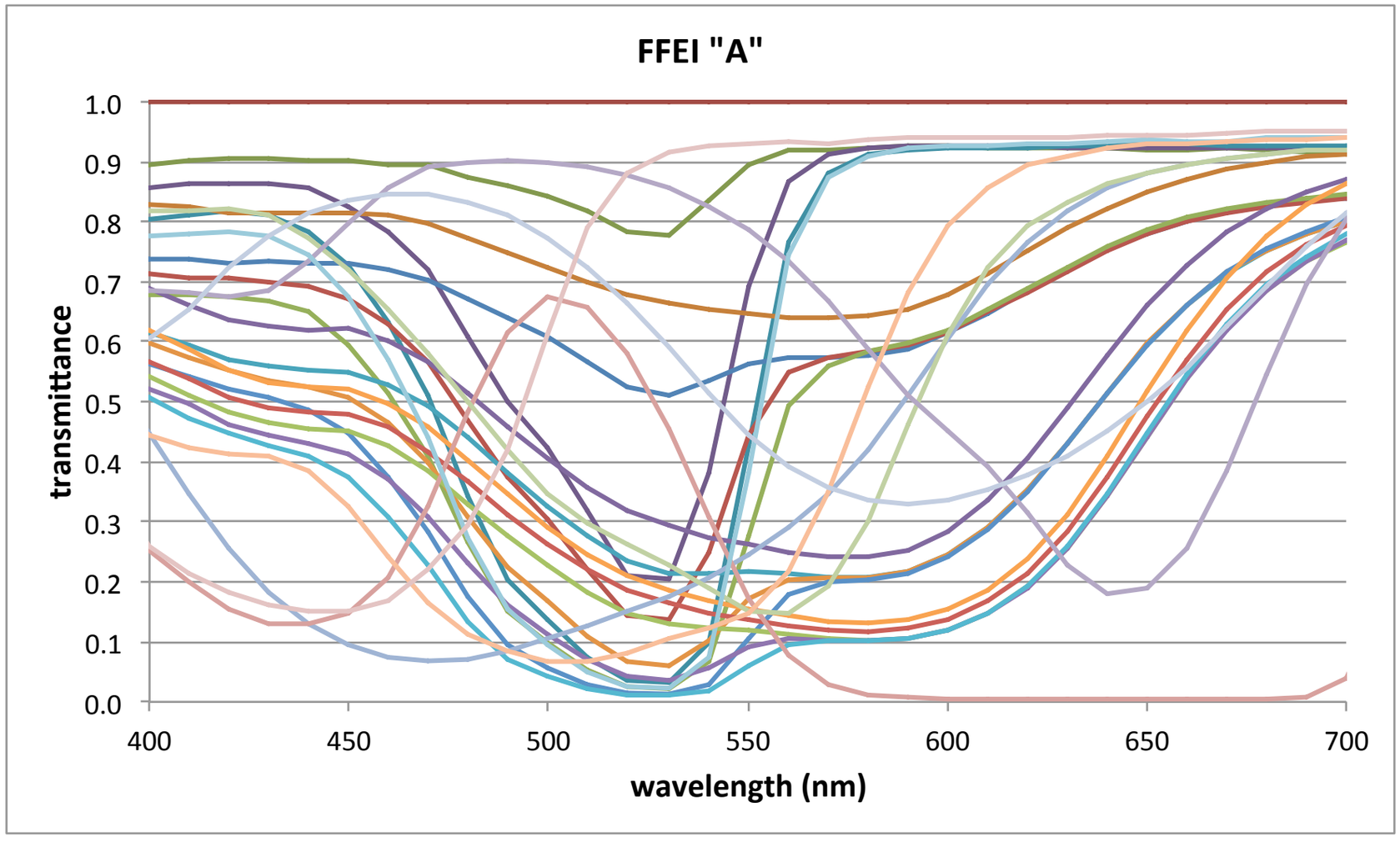
Transmittance Results FFEI



From Slide 2014.d.0002
Calibration Relative to Sample #1

Difference from open port calibration
increases with increasing transmittance

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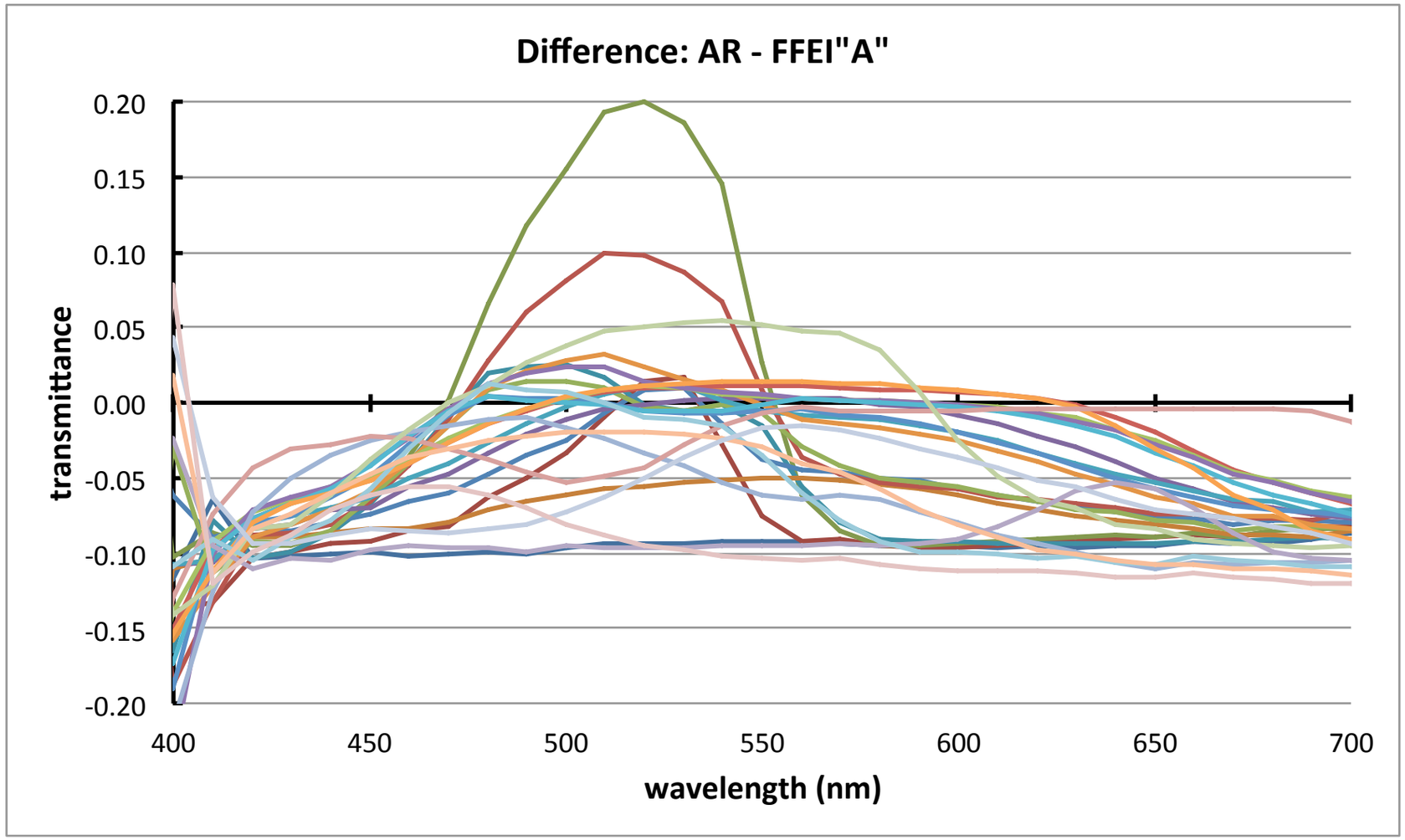
Transmittance Difference
AR - FFEI



Beside the 10% offset, a few patches show a likely wavelength mismatch between the two instruments.

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Discussion

- Is the calibration procedure defined?
- FFEI procedure normalizes transmittance to sample #1.
- Omnyx procedure is to isolate the transmittance of the sample.
- Techniques are interchangeable if the appropriate raw data are saved. Requires one additional measurement for FFEI (open port).

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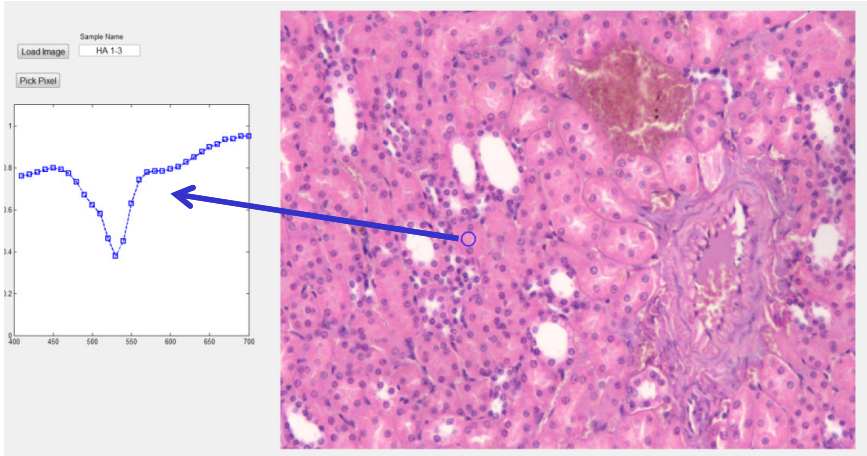
datacolor

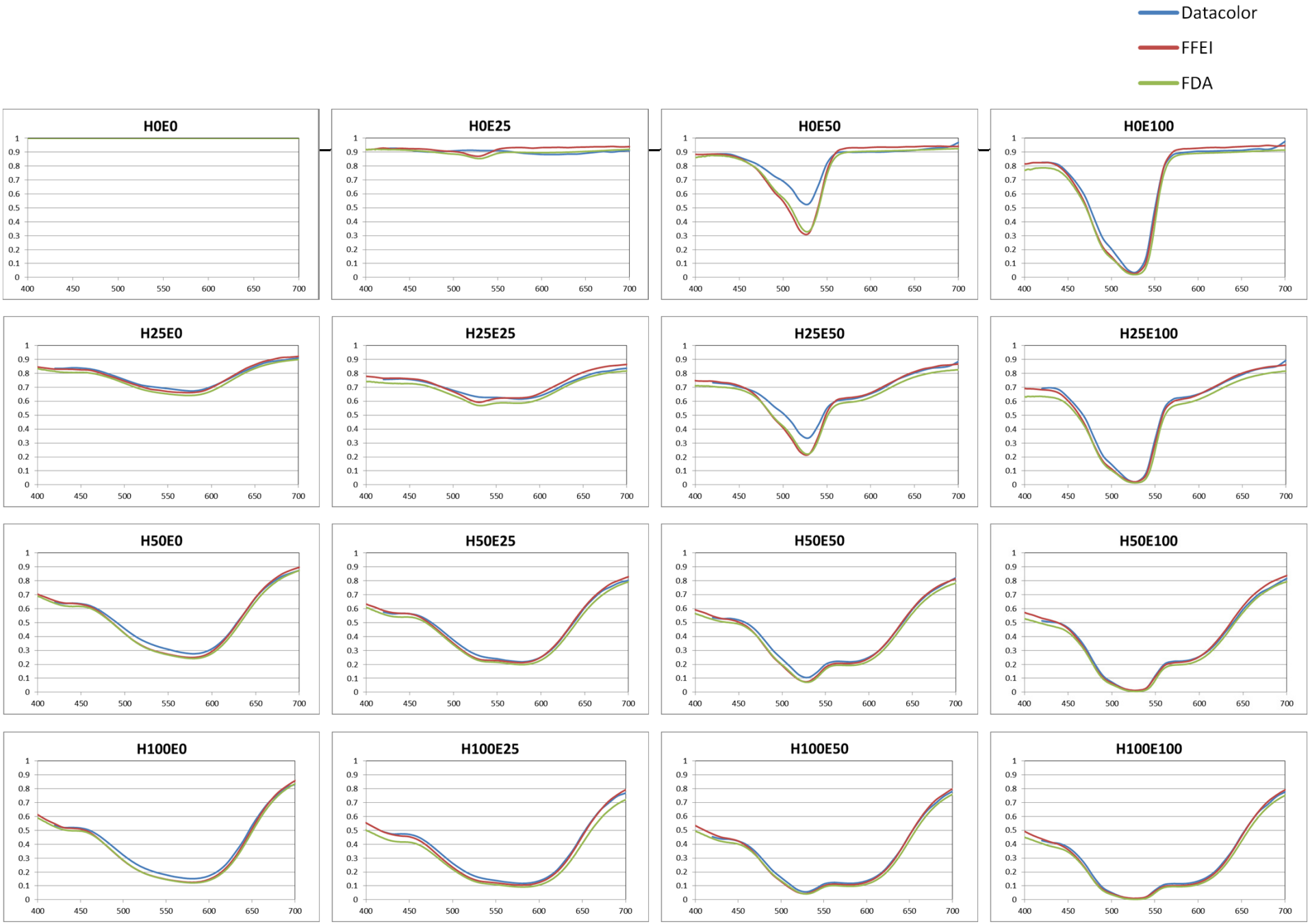
Transmission Spectra of FFEI Sierra Slide (2014.d.0001)

Transmission Spectra Collection with Multi-spectral Camera on a microscope*

- **Microscope:** Zeiss Axio Scope A1
- **Objective:** Zeiss N-Achroplan 20x
- **Light Source**: Quartz Tungsten Halogen (QTH)
- **Camera:** Qimaging QiClick (1392 x 1040)
- **Band**: 29 bands, 420-700nm, 7nm bandwidth (LCTF from Caliper)
- **Dynamic Range**: 12 bits
- **Color Accuracy**: ~1 ΔE to a NIST certified spectrometer
- **Measurement spot size:** 0.18x0.18mm^2
- **Measurement date:** 12/02/2014



* Hong Wei, Michael H. Brill, Taeyoung Park, **Evaluation of targets for color calibrating digital images from an optical bright-field transmission microscope**, Color Research and Application, in publication, http://onlinelibrary.wiley.com/doi/10.1002/col.21932/full


Datacolor
FFEI
FDA
H0E0
H0E25
H0E50
H0E100
H25E0
H25E25
H25E50
H25E100
H50E0
H50E25
H50E50
H50E100
H100E0
H100E25
H100E50
H100E100

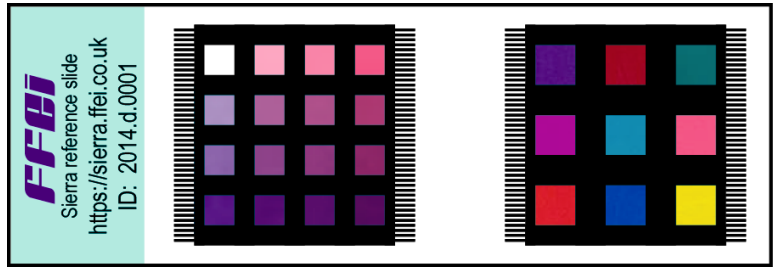

datacolor

Round-robin status update

Sierra
Calibration Assessment Slide

Round-robin status update (January 2015)

W Craig Revie
FFEI Limited



Outline of this presentation

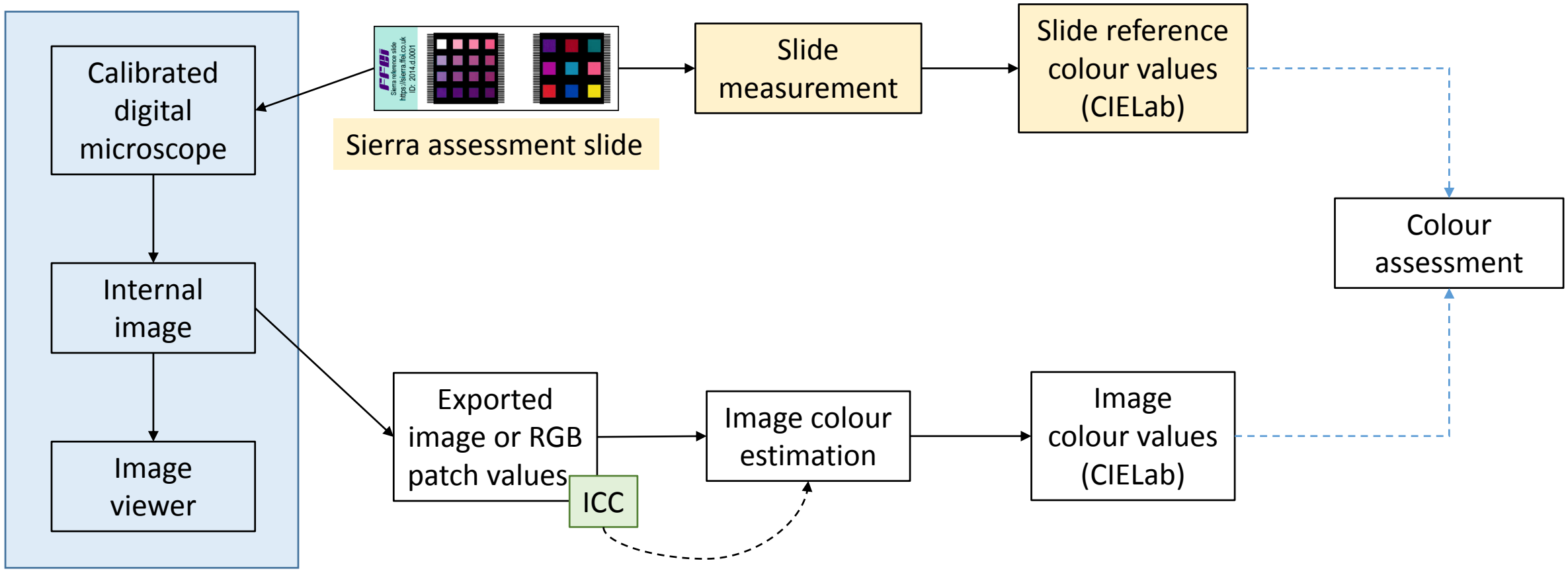
- Current status of round-robin assessment
- Details of assessment method
- Feedback received to date
- Next steps for the round-robin assessment

Current status

Please help by posting results on the Sierra web site

Organisation	Participant	Comments
FDA	Wei-Chung Cheng	Measured and scanned slide
Leeds University Hospital	Darren Treanor	Scanned slide
Leica	Allen Olson	Scanned slide
Ventana	Glenn Davis	Measured and scanned slide
Philips	Bas Hulsken / Prarthana Shrestha	Scanned slide (sRGB)
Datacolor	Hong Wei	Measured and scanned slide
GE Omnyx	Vipul Baxi / Dave Wyble	Measured slide – to be scanned
Massachusetts General Hospital	Pinky Bautista	Scanned slide on one system – more to follow
Konica Minolta	Po-Chieh Hung	Measured slide
Tokyo Institute of Technology	Masahiro Yamaguchi	New slides have been produced and will be shipped shortly
Biomerieux	Jérémie Pescatore	
XRite	James Vogh	
Lumenera	Nick Bulitka	

Assessment method



Calculation of slide reference CIEXYZ values

$$X = \sum_{\lambda} S_\lambda \times T_\lambda \times \bar{x}_\lambda \qquad X_n = \sum_{\lambda} S_\lambda \times \bar{x}_\lambda$$

$$Y = \sum_{\lambda} S_\lambda \times T_\lambda \times \bar{y}_\lambda \qquad Y_n = \sum_{\lambda} S_\lambda \times \bar{y}_\lambda$$

$$Z = \sum_{\lambda} S_\lambda \times T_\lambda \times \bar{z}_\lambda \qquad Z_n = \sum_{\lambda} S_\lambda \times \bar{z}_\lambda$$

T_λ is the ***relative spectral transmittance*** of the patch (relative to white patch)
X_n, Y_n, Z_n are the tristimulus values for the illuminant
S_λ is the spectral power distribution of the ***reference illuminant (D50)***
$\bar{x}_\lambda, \bar{y}_\lambda, \bar{z}_\lambda$ are the CIE 1931 colour matching functions

Data for D50 and for $\bar{x}_\lambda, \bar{y}_\lambda, \bar{z}_\lambda$ is available from http://files.cie.co.at/204.xls

Calculation of slide reference CIELab values

$$L_x = f\left(\frac{X}{X_n}\right) * 116 - 16$$

$$L_y = f\left(\frac{Y}{Y_n}\right) * 116 - 16$$

$$L_z = f\left(\frac{Z}{Z_n}\right) * 116 - 16$$

$$f\left(\frac{X}{X_n}\right) = \left(\frac{X}{X_n}\right)^{\frac{1}{3}} \quad \text{if } \left(\frac{X}{X_n}\right) > \left(\frac{6}{29}\right)^3$$

$$f\left(\frac{X}{X_n}\right) = \left(\frac{841}{108}\right)\left(\frac{X}{X_n}\right) + \frac{4}{29} \quad \text{if } \left(\frac{X}{X_n}\right) \leq \left(\frac{6}{29}\right)^3$$

With similar equations for Y and Z.

Source ICC Profile Specification Annex A
http://www.color.org/specification/ICC1v43_2010-12.pdf

Relative spectral transmittance of the patch (T_λ)

Creative Imaging Technology

Measurements file for each slide was created by FFEI and is available from https://sierra.ffei.co.uk/

Relative spectral transmittance from 380:800 nm (T_λ)

ISO28178																	
ORIGINAT	FFEI Limited																
DESCRIPT(	Sierra calibration assessment slide																
SERIAL	2014.d.0002																
CREATED	06/06/2014																
FORMAT_'	1																
INSTRUME	FFEI / Hamamatsu test rig																
NUMBER_	53																
BEGIN_DATA_FORMAT																	
SAMPLE_I	PatchName	Measuren	PatchX	PatchY	PatchWid	PatchHeig	Measuren	Measuren	UniformR	SPECTRAL_380	SPECTRAL_390	SPECTRAL_400	SPECTRAL_410	SPECTRAL_420	SPECTRAL_430	SPECTRAL_440	SPECTRAL_450
END_DATA_FORMAT																	
NUMBER_	50																
BEGIN_DATA																	
A1	H0E0	Mean	0	0	3	3	0	0	0	1	1	1	1	1	1	1	1
A2	H0E25	Mean	5	0	3	3	0	0	0	0.898890193	0.885033823	0.894140688	0.901182362	0.904598719	0.905642286	0.902823798	0.903809112
A3	H0E50	Mean	10	0	3	3	0	0	0	0.869149593	0.857141506	0.856683901	0.86377907	0.86536508	0.865037301	0.855936817	0.826616779
A4	H0E100	Mean	15	0	3	3	0	0	0	0.842899411	0.81303741	0.803548899	0.810905191	0.817135858	0.811522362	0.784411469	0.725915665
A5	H25E0	Mean	0	5	3	3	0	0	0	0.839513194	0.830188825	0.827022335	0.825572831	0.815986662	0.815908136	0.813458709	0.81388336
A6	H25E25	Mean	5	5	3	3	0	0	0	0.757256251	0.747400329	0.739387115	0.737767397	0.732518013	0.735597478	0.731522425	0.729656824
A7	H25E50	Mean	10	5	3	3	0	0	0	0.741723679	0.722278172	0.714161774	0.707186605	0.707332265	0.700006611	0.691916828	0.67166944
A8	H25E100	Mean	15	5	3	3	0	0	0	0.71395145	0.687782277	0.677039949	0.677111531	0.674746676	0.669358169	0.649050646	0.595294184
A9	H50E0	Mean	0	10	3	3	0	0	0	0.71148624	0.706612241	0.689705307	0.660026203	0.636598656	0.6259645	0.619007147	0.62187989
A10	H50E25	Mean	5	10	3	3	0	0	0	0.644645257	0.628303039	0.615297021	0.593576311	0.570755635	0.558255758	0.553926747	0.550709453
A11	H50E50	Mean	10	10	3	3	0	0	0	0.633889875	0.61104625	0.596975535	0.57314085	0.552408002	0.536523188	0.525511399	0.508116682
A12	H50E100	Mean	15	10	3	3	0	0	0	0.609181424	0.588971754	0.563112012	0.543311221	0.521187869	0.506568571	0.485436455	0.447533144
A13	H100E0	Mean	0	15	3	3	0	0	0	0.615513872	0.591437474	0.566943285	0.538905358	0.508863936	0.489924805	0.481103081	0.478556718
A14	H100E25	Mean	5	15	3	3	0	0	0	0.596657812	0.566484129	0.543282355	0.509588867	0.48239242	0.463519798	0.455023255	0.449676711
A15	H100E50	Mean	10	15	3	3	0	0	0	0.578287631	0.545536544	0.521231659	0.496317804	0.463264578	0.442907237	0.431389391	0.41292865

Patch measurements have been made by a number of participants which show good agreement with published values

Use of D50 as a reference illuminant

- D50 is probably not the best reference but was used for ease of comparison
  - All other options require some form of chromatic adaptation (see http://www.brucelindbloom.com/index.html?Eqn_ChromAdapt.html)
- Other candidates
  - The measured SPD of a ‘typical’ optical microscope, perhaps an average of some kind
  - The SPD of the whole slide imaging system (this is never viewed)
  - CIE Illuminant E (a synthetic flat spectrum)

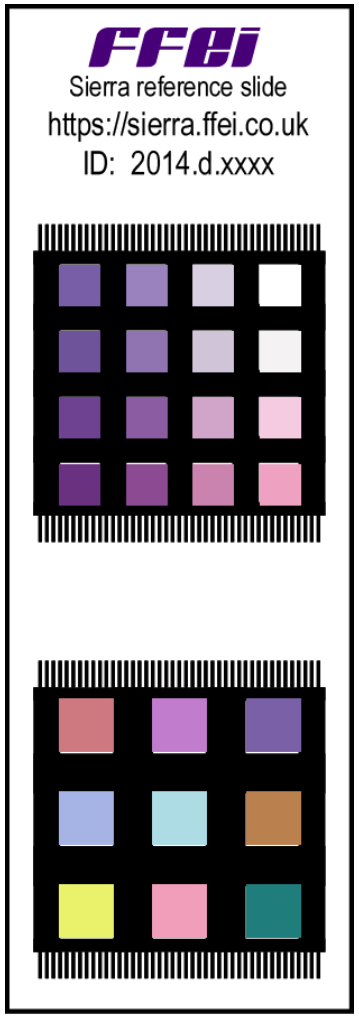
- Data for D50 and for $\bar{x}_\lambda, \bar{y}_\lambda, \bar{z}_\lambda$ is available from http://files.cie.co.at/204.xls

Reference slide CIELab values

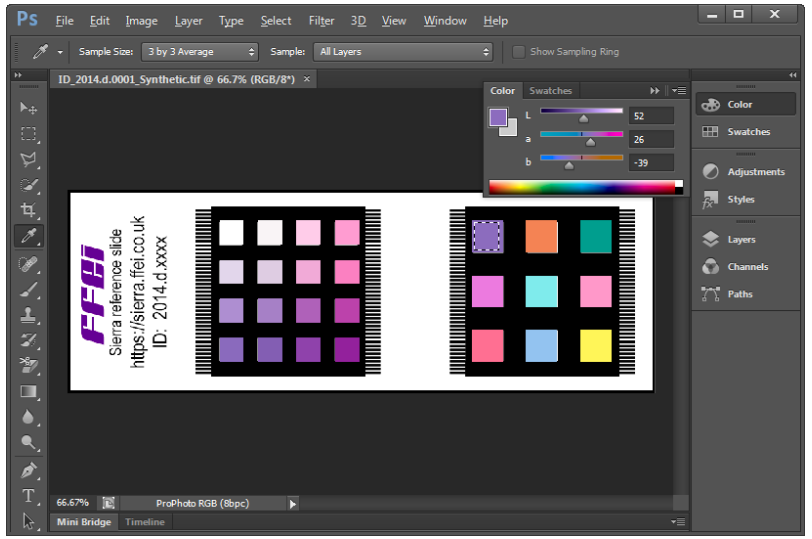
Synthetic reference image in ProPhoto RGB for slide ID_2014.d.0001

When displayed on a calibrated wide gamut display this image matches the reference slide illuminated by D50

Note that several of these patches are outside of the colour gamut of some displays (see following slide)

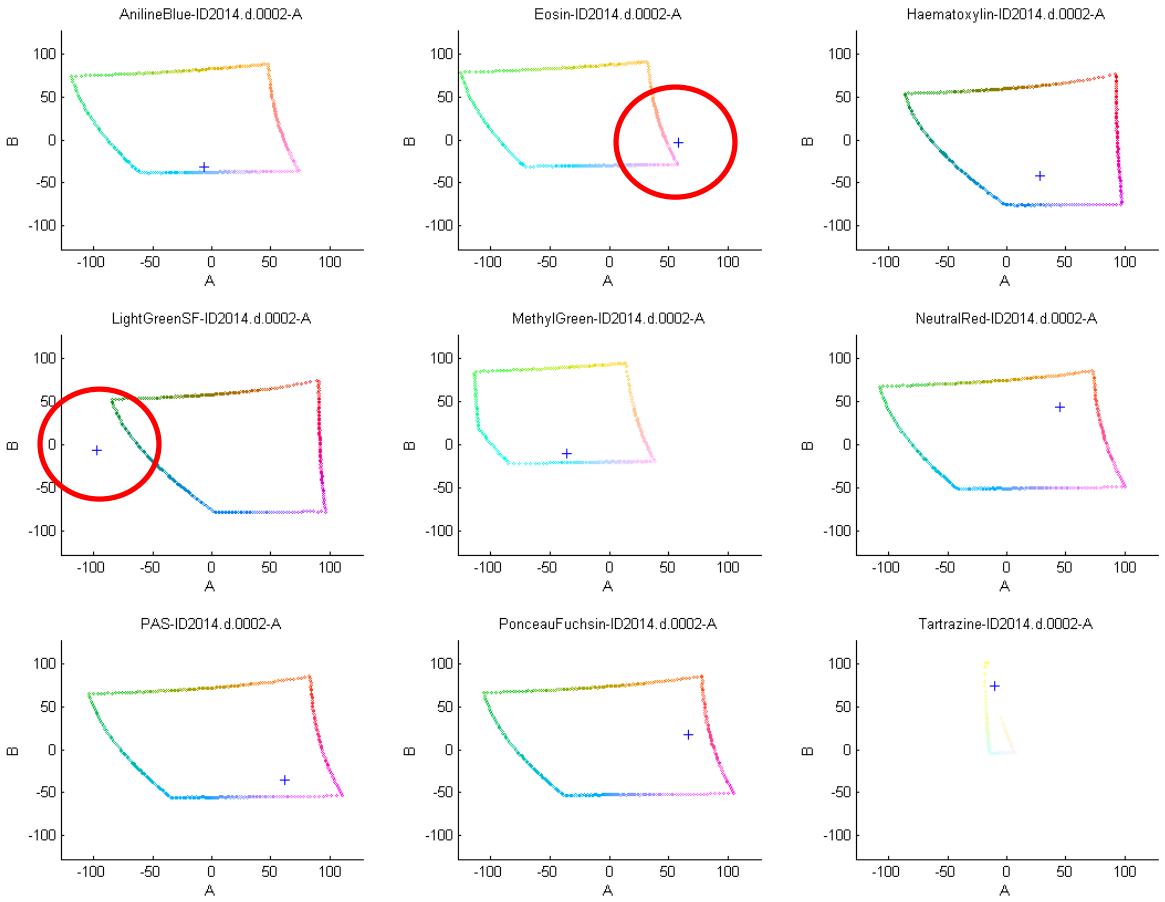


Patch Name	Lab_L	Lab_a	Lab_b
H0E0	99.9988	0.0033	-0.0044
H0E25	96.6426	2.2968	-0.3818
H0E50	88.8474	27.9223	-4.6433
H0E100	80.1688	53.3615	-4.1687
H25E0	87.1097	6.9449	-8.7922
H25E25	84.2053	9.0656	-8.5593
H25E50	77.5895	31.5652	-12.2809
H25E100	69.6112	53.5979	-11.3816
H50E0	64.0146	21.7882	-29.9941
H50E25	59.5005	24.7506	-30.794
H50E50	53.2755	42.6467	-32.911
H50E100	49.2011	57.2553	-31.1975
H100E0	50.9944	25.9697	-39.4892
H100E25	47.0626	28.5534	-40.0369
H100E50	42.4234	44.7031	-42.1123
H100E100	37.7625	55.9028	-40.2539
Haematoxylin	51.9317	25.364	-38.4756
NeutralRed	67.48	41.1816	45.0063
LightGreenSF	52.984	-91.0031	-10.5381
PAS	67.5002	54.2691	-31.4764
MethylGreen	86.6407	-32.4549	-10.5291
Eosin	79.564	55.571	-1.1358
PonceauFuchsin	68.1692	61.1493	13.2545
AnilineBlue	76.7327	-7.7321	-27.6187
Tartrazine	95.6619	-9.1693	73.1616



Photoshop can be used to inspect patch colour values using Eyedropper tool

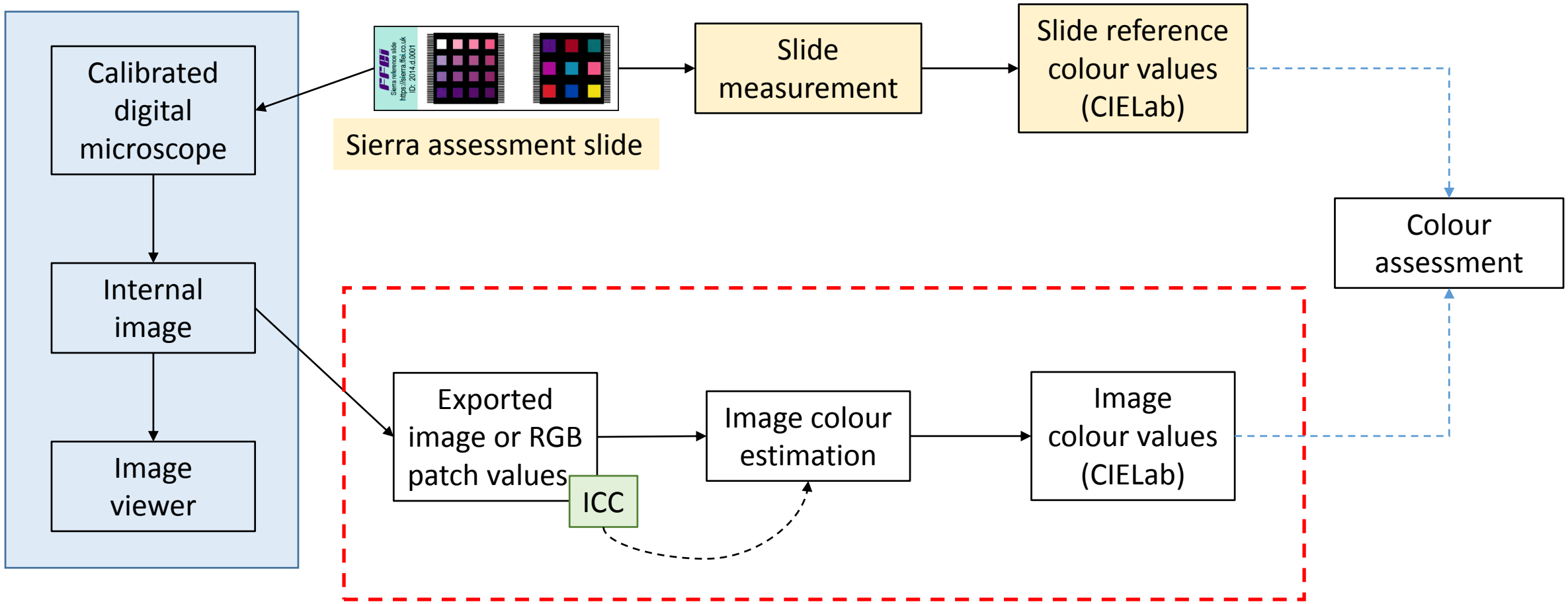
Reference slide colours vs Adobe RGB



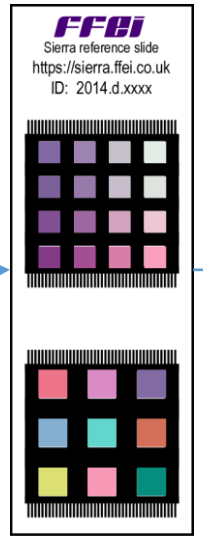
Note that some colours are out of gamut for Adobe RGB which has a significantly larger colour gamut than sRGB

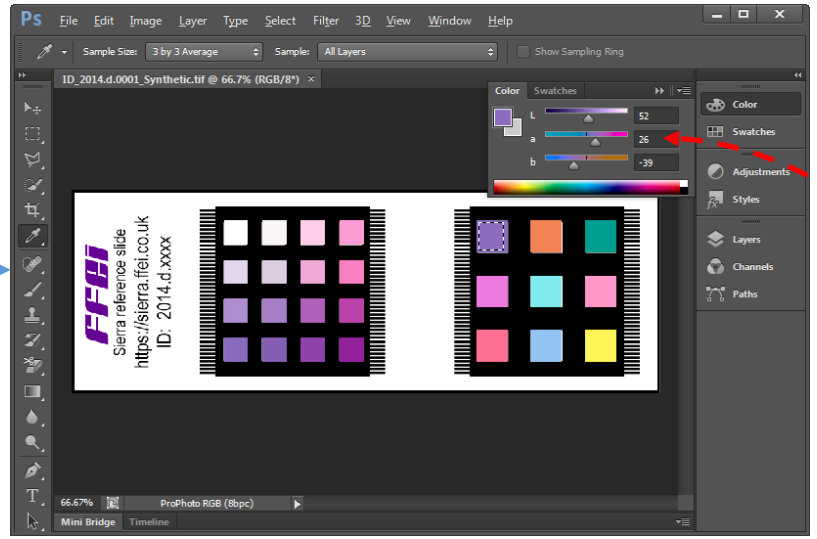
This may result in some clipping – as far as I am aware no one has conducted a study to determine whether this could affect diagnostic outcome but care should be taken when preparing colours for an sRGB workflow

Assessment method



Calculation of Lab values from RGB





RGB values
+ ICC Profile

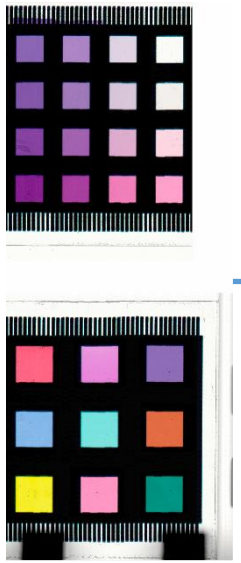
MATLAB method
Uses CIELABD50.icc – a simple Lab ICC Profile (does not work with the latest version of Photoshop)

Image Lab values

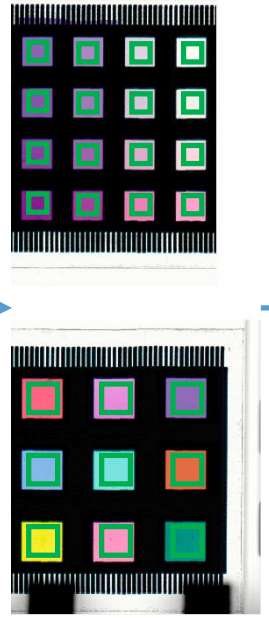
Sanity check

Calculation of Lab values from scanned image

ICC Profile may be embedded in image



Typical scanned image (TIFF)



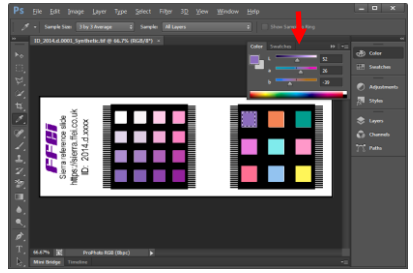
Patches identified

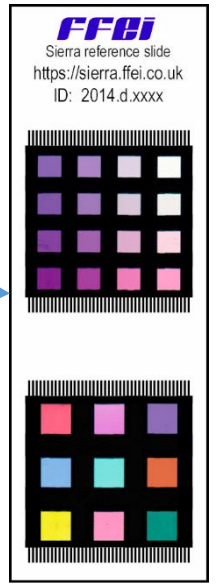
Average RGB values for central 70% calculated

RGB to Lab conversion

Image Lab values

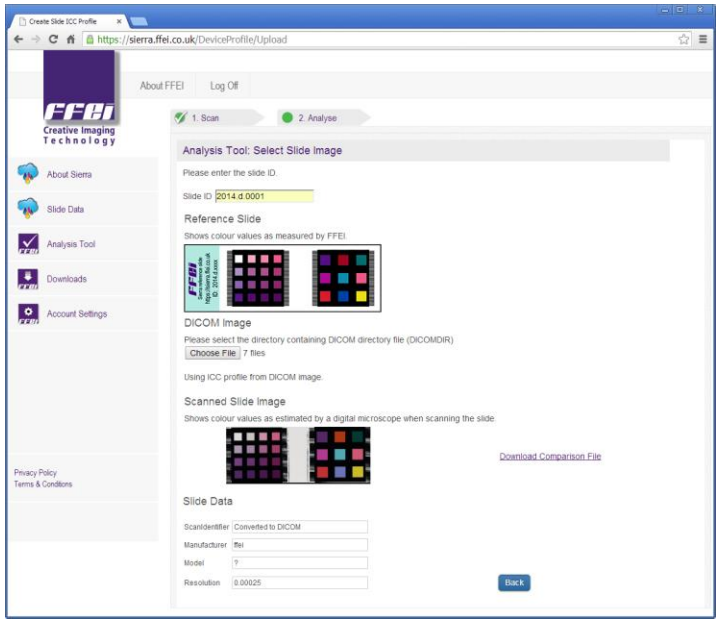
Sanity check





Synthetic image with embedded ICC Profile

Calculation of Lab values (Sierra Analysis Tool)

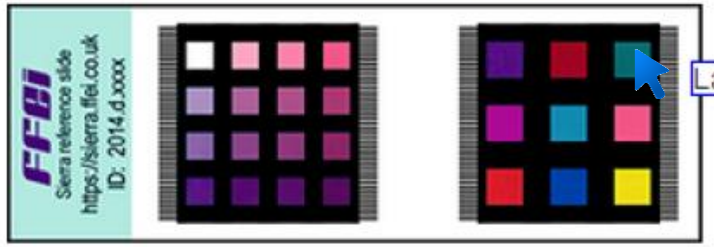


HTML5-based tool – works best in Chrome currently

Requires a DICOM image of slide on local PC

Reference Slide

Shows colour values as measured by FFEI.



Lab_Ave(53.01, -88.75, -7.85), Lab_Point(52.12, -87.63, -8.05)

Scanned Slide Image

Shows colour values as estimated by a digital microscope when scanning the slide.

Lab_Ave(50.09, -84.64, -11.87), Lab_Point(49.28, -85.68, -10.93)

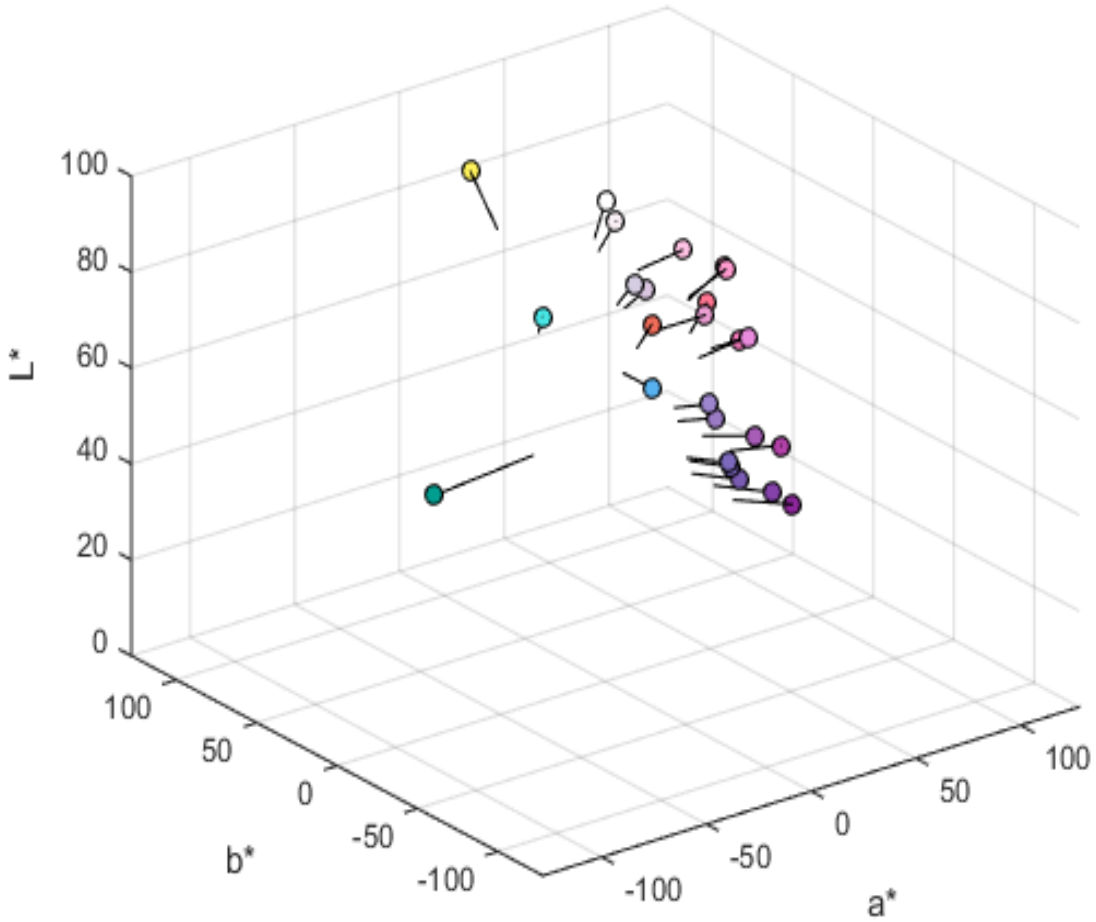
Download Comparison File

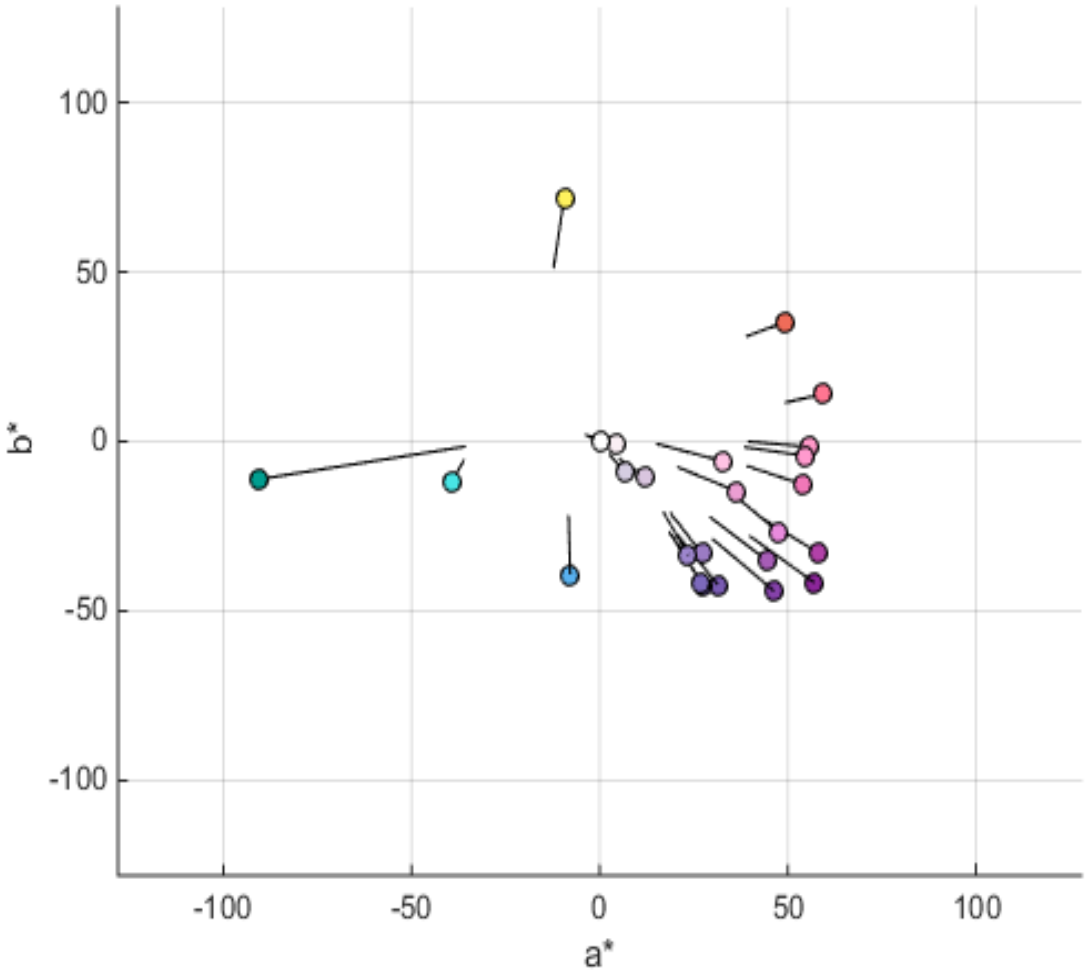
Analysis: synthetic images

Visual comparison limited by display

Analysis: plot of Lab values

Demo





Feedback from the round-robin assessment

- Please provide a short summary of what you think should be changed with the Calibration Assessment Slide in order to make it more useful

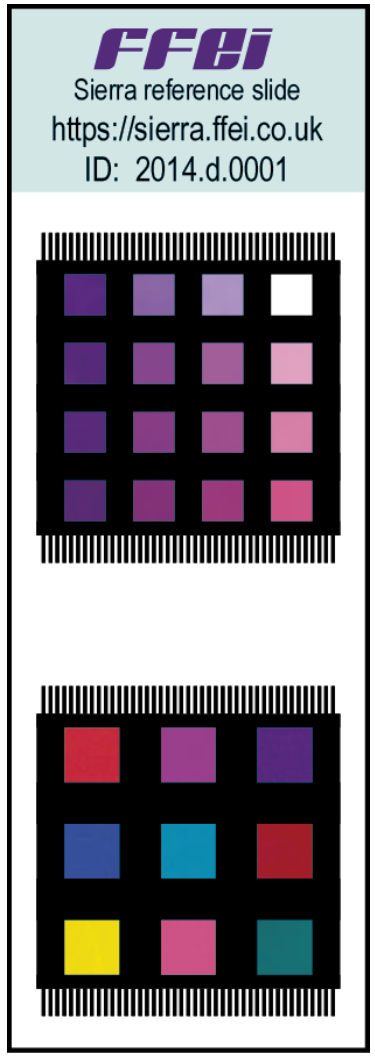
- Observations to date:
  - Area covered by the patches is larger than the scan area for some systems
  - Patch uniformity is poor and should be improved
  - Some patches fade – improve method of applying inhibitor
  - Black lines on slide make it difficult to scan on some systems
  - Distribution of H&E colours could be improved
  - Handling over-white values
  - Measuring and incorporating flare

- Note that FFEI does not currently have a plan to manufacture this slide but is looking for a suitable partner to bring it to market

The need for an alternative assessment method

- As part of FFEI's Sierra project we developed a method to allow the colour of a digital microscope to be assessed using a DICOM image
- Although vendors expect to be able to export DICOM images from their system at some point this is not a function currently supported by everyone and so there is a need for an alternative assessment method at least for the short term
- The primary motivation for this assessment is so that assessors / users of whole slide imaging systems have some way of seeing the colours present on the slide - this may be presented by the user in the form of a user interface control 'show actual colours'
- The feedback from the round-robin assessment is that the Sierra Calibration Assessment Slide with a suitable (ideally standardised) assessment method provides a good way to show how colour is being handled by each system

Exported image (proposed)



- RGB TIFF with lossless compression
- Image size of around 1920 x 662 pixels
- Should include an embedded ICC Profile that shows how the image will be presented to the user
- Image of the whole slide including the label allows identification of the reference measurement file (is this easily possible?)
- The exported image must have the same RGB colour values as the high resolution image of the slide – this should be demonstrated as part of any regulatory approval process

The image could be created using an ‘export’ function on the scanner and would be available as a record of the calibration state of the scanner

Review of results and publication

- Phase 1: round-robin participants only
  - Results anonymised and sent to all participants
  - Participants will know which are their results so that they can be checked
  - Results review teleconference will be set up to discuss results
  - Perhaps repeat some tests (?)
- Phase 2: review of results in wider group
  - Aim to develop and publish assessment criteria

- Complete white paper *Digital microscope test materials and test methods*
  - http://www.color.org/groups/medical/Digital_microscope_test_materials_and_test_methods-v3.pdf

- Timescale – aim to conclude by mid 2015

Discussion

Next steps for colour calibration assessment

- Complete round-robin assessment and publish results
- Complete white paper

- Other topics
  - Multi-spectral DICOM extension – Robert Horn asks ‘Will there be something ready that wants time on the DICOM WG-06 agenda in March?’

CIE Reportership

- **Title: Common colour appearance**
- **Reporter: Craig Revie (UK)**
- **Terms of reference**

To study the topic of common colour appearance to determine whether people mean the same thing when they use this term.

The report will collect examples of what people refer to as common colour appearance including for displays, printing systems and brand management. The report will also identify some counter examples.

Note: One aim of this work is to explore how we might conduct a series of tests to determine whether common colour appearance is a shared and quantifiable concept.