Universitat d'Alacant
Universidad de Alicante

le cnam

Paris, 4th – 5th May 2017

Kick-Off Meeting

BiRD: WP2

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BiRD
Bidirectional Reflectance Definitions
JRP 16NRM08

Color & Vision Group
http://web.ua.es/en/gvc

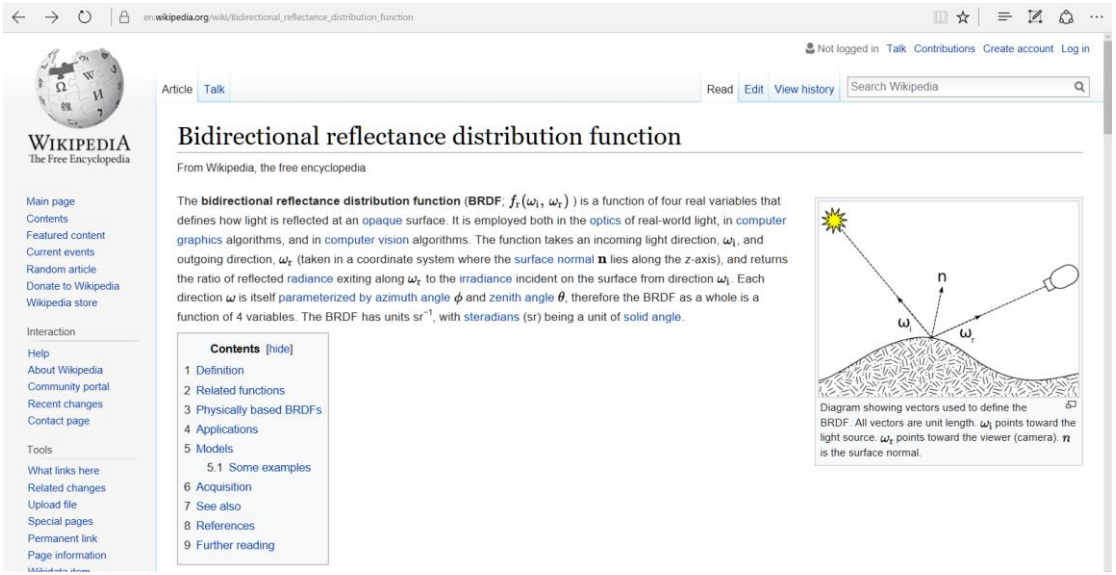
Outline: WP2

- Definition & Justification
- Objectives & Strategy
- Tasks
- Activities
- Chronogram & Deliverables
- Risks
- Conclusions

WP2: definition & justification

- **Spectral and photometric BRDF data seems a Big Data challenge at different levels of visual appearance for materials**
  - **Color**
  - **Gloss**
  - **Texture: sparkle & graininess**

WP2: definition

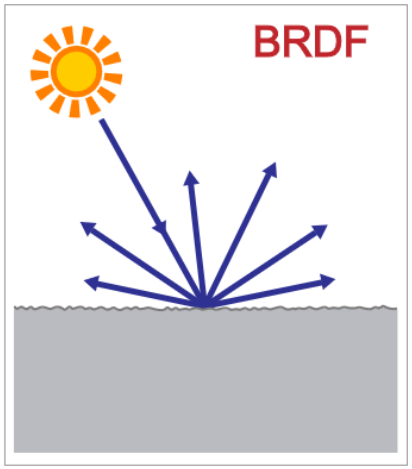


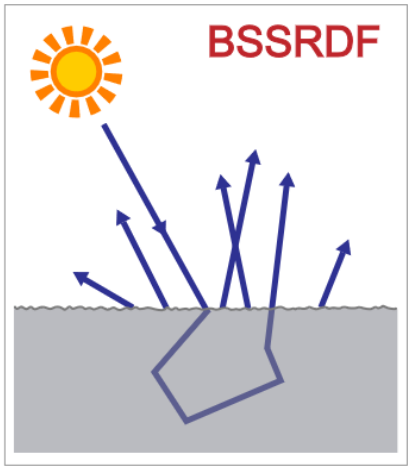
Bidirectional reflectance distribution function

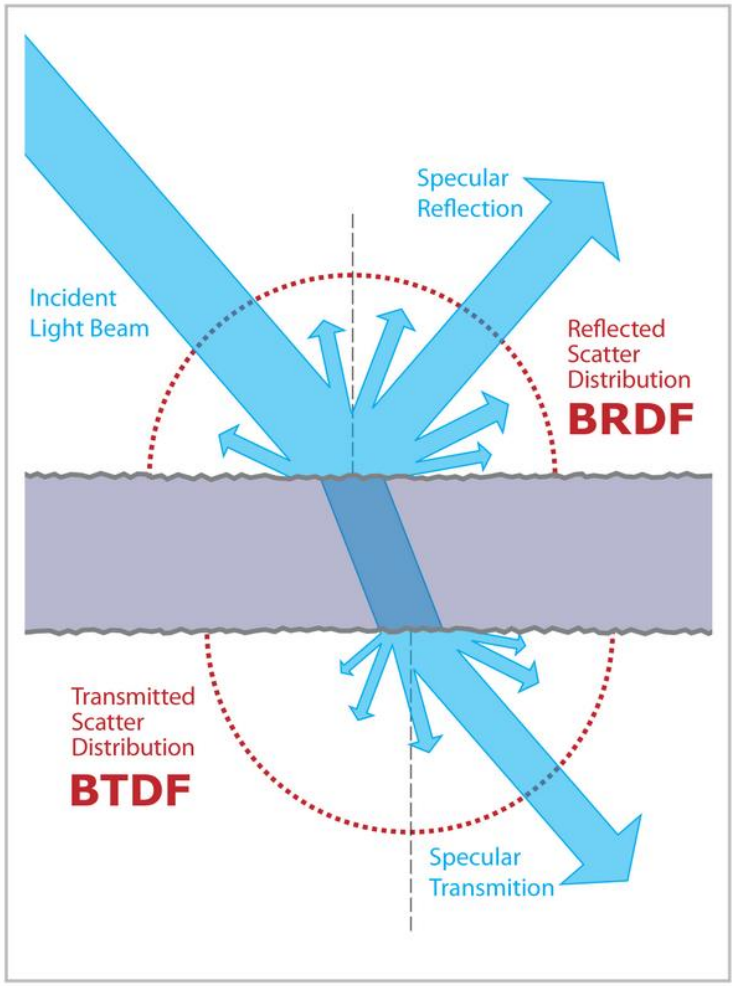
From Wikipedia, the free encyclopedia

The **bidirectional reflectance distribution function** (**BRDF**; $f_r(\omega_i, \omega_r)$) is a function of four real variables that defines how light is reflected at an opaque surface. It is employed both in the optics of real-world light, in computer graphics algorithms, and in computer vision algorithms. The function takes an incoming light direction, ω_i, and outgoing direction, ω_r (taken in a coordinate system where the surface normal $\mathbf{n}$ lies along the z-axis), and returns the ratio of reflected radiance exiting along ω_r to the irradiance incident on the surface from direction ω_i. Each direction ω is itself parameterized by azimuth angle ϕ and zenith angle θ, therefore the BRDF as a whole is a function of 4 variables. The BRDF has units sr^{-1}, with steradians (sr) being a unit of solid angle.

Diagram showing vectors used to define the BRDF. All vectors are unit length. ω_i points toward the light source. ω_r points toward the viewer (camera). n is the surface normal.

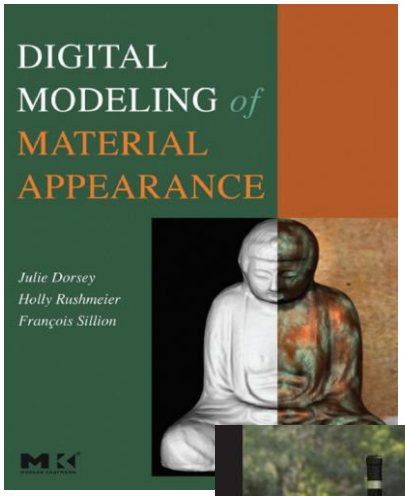


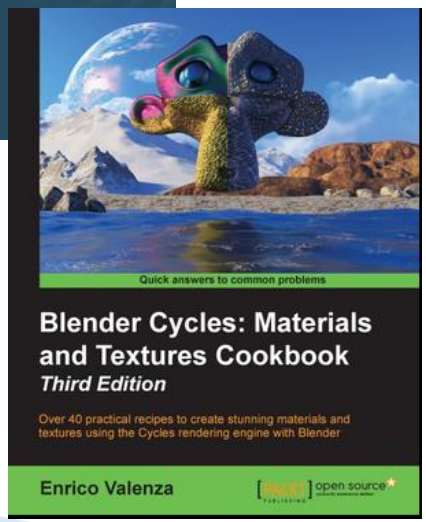


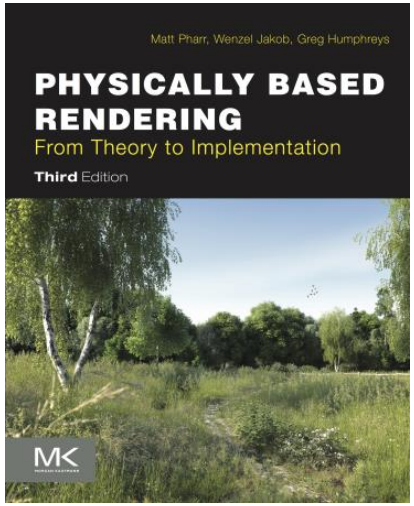


WP2: definition

- **Books, papers, proceedings, etc.**







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STAR – State of The Art Report

BRDF Representation and Acquisition

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WP2: justification

- **Progress beyond the state of art and results**
  - **Universal BRDF format to be developed by consensus**
    - **BRDF communities:**
      - **Metrologists (BiRD consortium + CIE)**
      - **Spectrophotometer manufacturers**
      - **Academics working on BRDF models**
      - **Developers of Virtual Reality and (3D) videogames**
      - **End users:**
        - **automotive, architecture, pulp & paper, 3D printers, etc**

WP2: justification

- **Impact**
  - **The uptake of the outputs of this project by the industrial community will enable the development of novel instruments which will increase the competitiveness of European industries.**
  - **The recommendations on the optical parameters for the measurement of BRDF will be crucial for instrument manufacturers to produce a new generation of spectrophotometers and to enable industrials to move from visual evaluation to objective BRDF measurement, leading to better control of the appearance of their products and less rejection by the customer.**

WP2: justification

- **Impact**
  - **The uptake of the recommendations for the characterisation of the full BRDF of goniochromatic visual effect pigments will support the production of multi-angle spectrophotometers and promote the confidence of end-users that the best geometries can be used to characterise the product.**
  - **In the absence of standardisation, the primary facilities developed for measuring BRDF are made to be very versatile in order to satisfy particular customer requirements. This increases the measurement time and the measurement uncertainty. The take up of the technical recommendation on BRDF will enable NMIs to develop transfer reference facilities that could be based on commercial instruments developed by stakeholders of the project. Existing calibration services can be automated at the NMI and calibration laboratory level, resulting in a reduction of calibration costs and time, and improvement of the traceability.**

WP2: justification

- **Need of this Work Package:**
  - **No standards or detailed recommendations exist for BRDF measurements and calibrations (Objectives 1 and 2)**
  - **This is also the case for BRDF data files that are extensively used nowadays as input in computer graphics software for different applications such as digital cinema, gaming, advertising, and architectural design. The consequence is that for each combination of measurement instrument and graphics software, the user is forced to develop its own small conversion software, which is generally a significant issue for most users.**

WP2: justification

- **State of the Art:**
  - **BRDF measurements generate a large amount of data that have to be ordered according to, for example, the angle of illumination and observation, wavelength, polarisation, spectral bandwidth and solid angle. Currently, no recommendations exist for the archiving of measurement files which means that measurements are archived in the data file, which is different for each device. Therefore, compatibility is not assured and it is the user who has to develop a short source code to ensure the communication between different devices. This situation is counterproductive. Clear evidence of this weakness can be found when comparing features and performances among different proprietary and open source software available in 3D rendering (AutoDesk, Blender, Catia, etc.), augmented & Virtual Reality, 3D Gaming, etc., using the same BRDF measurement file as input [9]. The same problem will soon happen with 3D printing design and management.**

WP2: justification

- **Beyond the state of the art:**
  - **This project will propose a convenient method to arrange BRDF data which will save time for new users and will facilitate communication between NMIs, instrument manufacturers and industry using BRDF data. It will allow the development of visualisation software that can work on a common raw data file and propose scientific visualisation modes like CIELAB in 3D or 3D projections, colour differences and tolerances for 2D and 3D objects. To carry this out, this project will:**
  - **• Propose a set of BRDF parameterisation techniques to estimate the full BRDF from a minimal number of measurement geometries.**
  - **• Develop a basic design of visualisation and management applet (source code, for instance by Matlab®), able to upload any BRDF file format and convert it into the universal BRDF file format.**
  - **• Promote this work by proposing free download of the open access code on the project website.**
  - **By doing this, this project will go beyond the state of the art in the field of BRDF communication and will promote the development of a new generation of visualisation software.**

WP2: potential outputs

- From the guidance on how to sample the BRDF efficiently and the proposal of arrangements for data handling according to the category of samples, the expected early impact is:
- • Reduction of the number of measurement geometries needed to adequately describe the chromatic variations in the goniochromatic colours, in any geometry in-plane and out-of-plane, thus helping to propose new commercial goniospectrophotometer designs.
- • Better communication between BRDF measurement devices and data visualisation software, both for scientific analysis and for multimedia applications.
- • Improvement of colour quality control following the progress and current success in the automotive sector, based on the management of BRDF data.
- • Facilitation of new disruptive innovations based on efficient management of visual appearance from BRDF data of natural and synthetic objects for new Brain-Machine interfaces, devices and applications/markets.

WP2: projected early impact

- **Metrological and scientific communities:**
  - **The take up of the technical recommendation on BRDF will enable NMIs to develop transfer reference facilities, which could be based on commercial instruments developed by stakeholders of the project. This will decrease the measurement time and price of calibrations for user.**
  - **On the topic of BRDF, gloss and sparkle, the pre-normative work undertaken by this project will support the development of a new generation of spectrophotometers that will increase the need for calibration and traceability. The metrological community will therefore be able to develop new calibration services.**

WP2: projected early impact

- **Relevant standards:**
  - **This project focuses on the characterisation of visual and optical properties of materials, which is part of the terms of reference of CIE Division 2.**
  - **As a result of the activity generated by IND52 xDReflect, CIE has recently established a new technical Committee, TC2-85, "Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF)".**
    - **The scope of this committee is fully in line with the first objective of this project and the consortium will produce a recommendation and submit it to this committee within the timeframe of this project.**

WP2: projected early impact

- **At long term:**
  - **Following on from the pre-normative work that this project is undertaking on BRDF, it might be possible for CIE to adopt in the future a standard observer based on the full BRDF measurement, potentially facilitating the management of the appearance as a whole.**

WP2: UA leadership

- UA has an extensive experience of BRDF measurement using commercial multi-angle spectrophotometers and has a large network with industrial organisations that are main users of these devices (automotive, cosmetic, pigments producers).
- UA has extensive knowledge of end-user needs and will be a good mediator to set up and promote the measurement data file arrangements.
- For this reason, UA will lead WP2 on the universal file format and basic scientific visualisation tools.

WP2: objectives

- **Propose arrangements for data handling and processing for BRDF measurements when a large amount of data is obtained.**

WP2: objectives

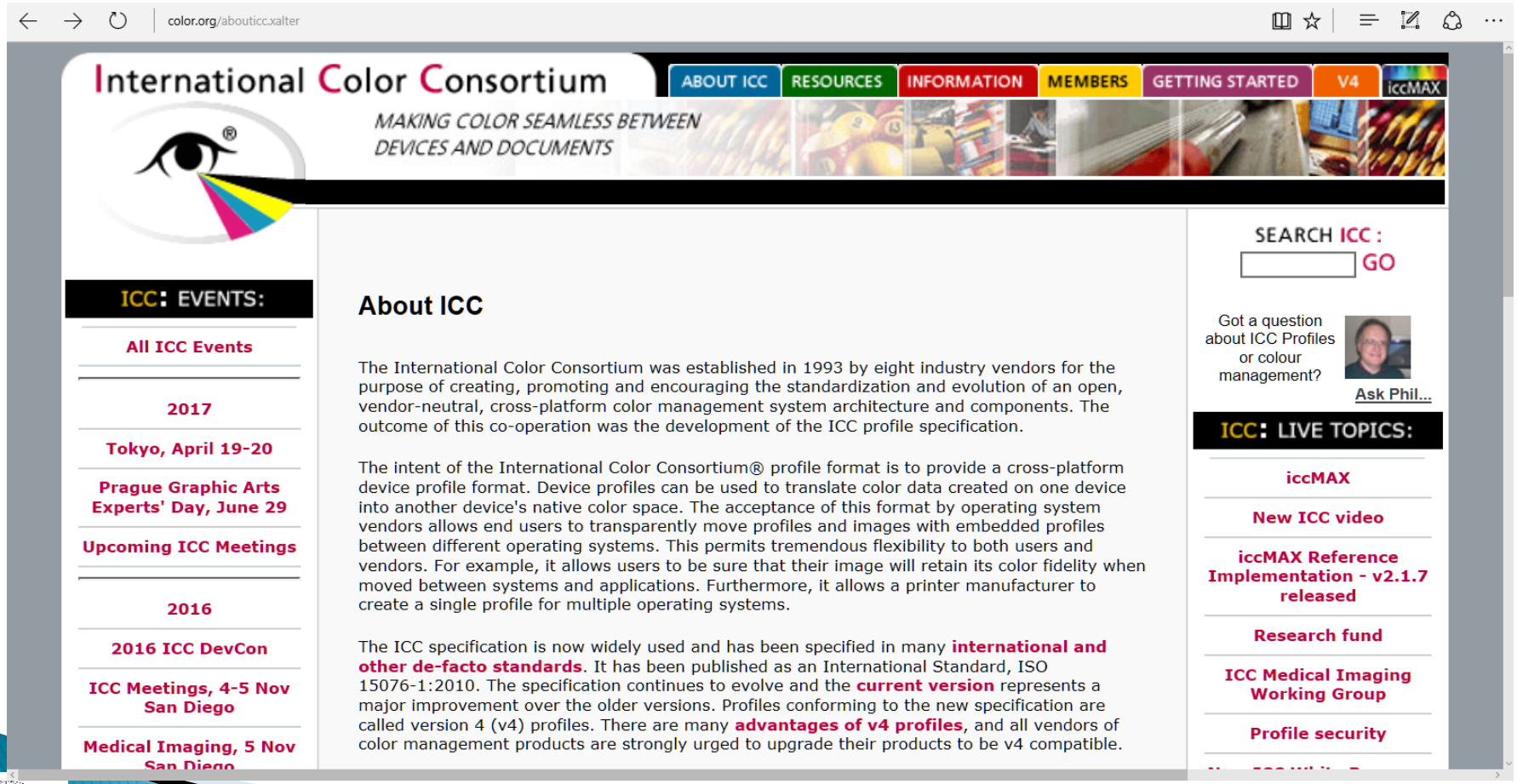
- **The aim of this work package is to provide recommendations on BRDF data handling and visualisation.**
- **It will include work on data format, basic visualisation modes, parametrisation, and conversion to visual appearance descriptors currently used in industry.**

WP2: objectives

- Establish a **universal** BRDF file format by consensus of producers and users of BRDF data (Task 2.1).
- Investigate relevant appearance descriptors **extracted** from the raw BRDF data and visualisation modes (Task 2.2).
- Propose a **basic** design of BRDF visualisation and management **applet**, and guidance on the utilisation and maintenance of the applet (Task 2.3).

WP2: strategy

- Like ICC consortium and standard in 90s



WP2: strategy

- **ICC profile format**
  - **Objective: WYSIWYG**
    - **Capture, visualization and printing**

- **BiRD motto:**
  - **What You See Is What You Measure Rightly = WYSIWYMR**
  - **Suggestions for other better sound acronym?**

WP2: task 2.1

- **UNIVERSAL BRDF FILE FORMAT**
- **The aim of this task is to establish a universal BRDF file format.**
- **To achieve this, a Research Forum (RF) will be set up in the framework of CIE activity that will facilitate discussion on BRDF.**
- **Partners of the consortium will organise and chair meetings of this RF.**
  - **Existing proposals of BRDF file formats e.g. Radiant Zemax file format, will be collated and the most representative files will be identified.**
  - **ETC (from Computer Graphics world, …)**
- **A proposal on a universal BRDF file format will be discussed within this RF and upon agreement, a technical note describing the arrangement of the universal BRDF file format will be written**

WP2: task 2.2

- **APPEARANCE DESCRIPTORS FROM BRDF DATA AND VISUALIZATION MODES**
- **The aim of this task is to provide pertinent appearance descriptors extracted from raw BRDF data.**
- **The basic approach will follow the photometric and colorimetric calculations for simple geometries but extend to multiple measurement geometries.**
  - **This will involve developing open source codes to plot and compare BRDF in polar mode, and colour travel in CIELAB space.**
  - **In addition, the standard RGB colour space (sRGB) or multi-primary encoding of BRDF colorimetry space will be used.**
  - **Appearance descriptors of BRDF colorimetry for quality control e.g. colour travel, alert for colour tolerance, will be developed. The codes will be validated by a partner who did not develop the codes.**

WP2: task 2.3

- **BRDF VISUALIZATION AND MANAGEMENT APPLET**
- **The aim of this task is to propose a basic free management applet (source code, i.e, by Matlab®), able to:**
  - **upload BRDF file format and convert it into the universal BRDF file format;**
  - **do the final conversion and downloading, from the universal format for any device/software dependent BRDF file;**
  - **include the open source codes developed in Task 2.2 and provide them in a user friendly software.**
- **This will follow on from the universal BRDF file format agreed with the RF in Task 2.1 and will involve:**
  - **i) collecting BRDF file formats used in commercial devices and rendering software,**
  - **ii) designing the interface and main functions of the applet, and**
  - **iii) making the initial version of the applet available to stakeholders and seeking feedback on it to improve the applet,**
  - **iv) writing a basic handbook for the utilisation and maintenance of the applet, and**
  - **v) disseminating its existence online.**

WP2: activities 2.1

- **Universal BRDF file format**

Activity number	Activity description	Partners (Lead in red)
A2.1.1	Aalto, with support of UA, CNAM, METAS and CSIC, will write a proposal for the establishment of a RF according to the protocol defined by CIE code of procedure. Aalto will then send the proposal to CIE.	Aalto, UA, CNAM, CSIC, METAS

- **Deadline: M5 (Sept. 2017)**
  - **First draft before mid June?**
- **Who in CIE? Research Forum composition??**

WP2: activities 2.1

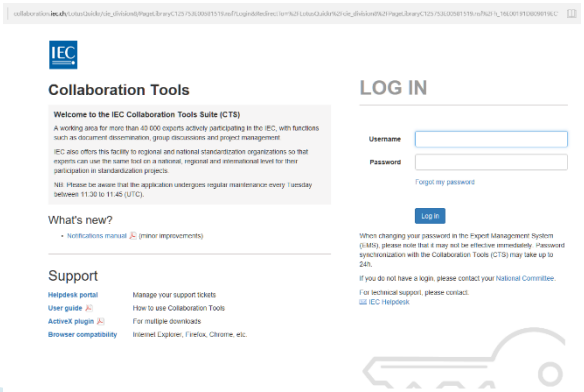
Activity number	Activity description	Partners (Lead in red)
A2.1.2	CMI will announce on the website by month 5 (September 2017) the creation of the RF and UA, Aalto, CNAM, CSIC, METAS and PTB will then disseminate the existence of the RF to different communities (members of CIE-TC2-85, metrologists, instrument manufacturers, developers of visualisation software, researchers on BRDF models, developers of augmented virtual reality games, movies, etc.) at conferences and meetings of standardisation bodies or as written information in cases where there is no conference or meeting at the appropriate time. The output from this activity to A2.3.6 will be available by month 32 (December 2019).	CMI, UA, Aalto, CNAM, CSIC, METAS, PTB

- **Deadlines: M5 (Sept. 2017) & M32 (Dec. 2019)**
  - **First web draft before September?**
- **PTB dissemination? Database of receivers??**

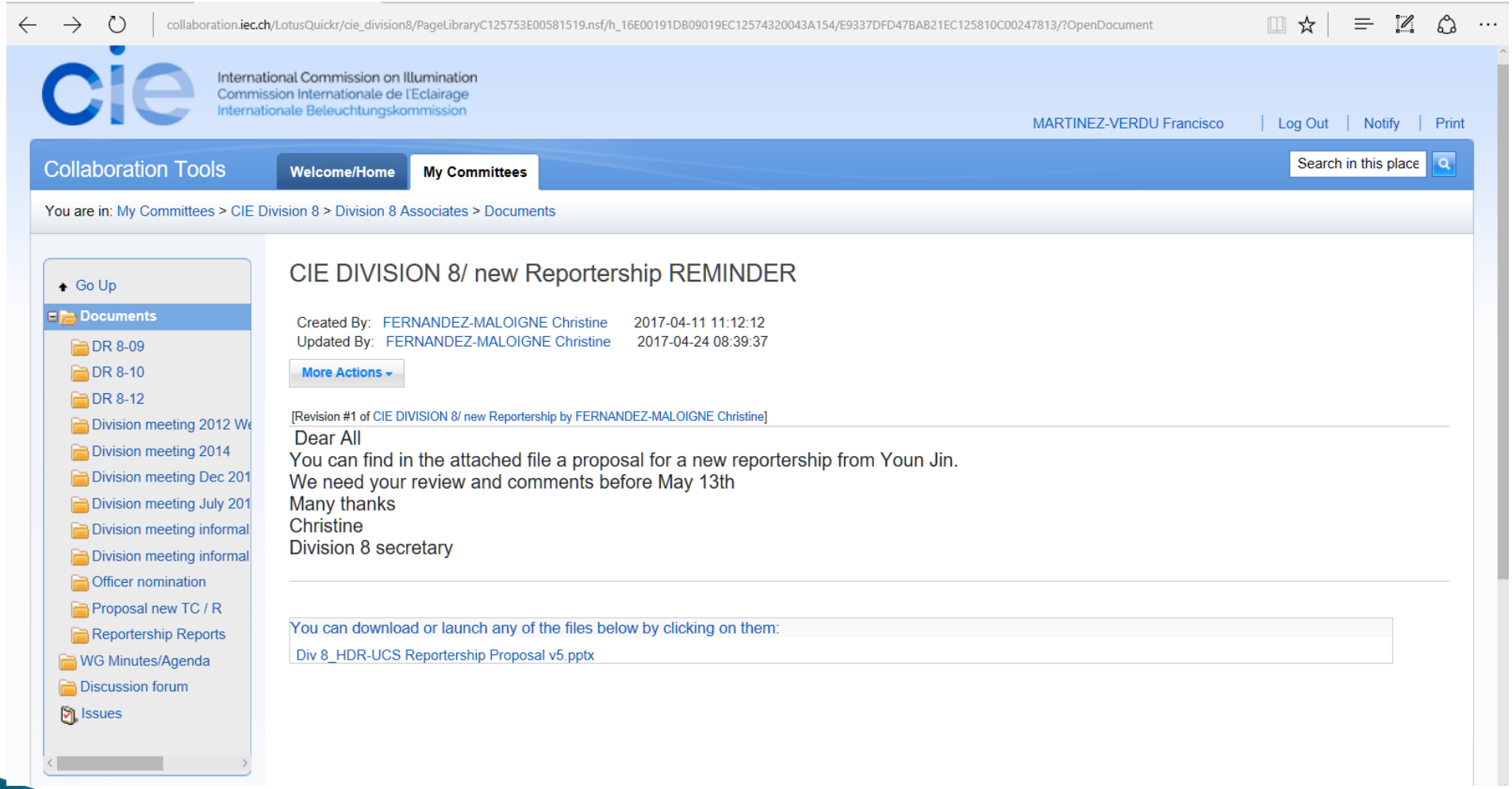
WP2: activities 2.1

Activity number	Activity description	Partners (Lead in red)
A2.1.3	Aalto, supported by UA, will follow the training requested by CIE for operation of a Research Forum and will take the lead of the RF by month 10 (Feb 2018) at the latest. The RF will focus on "BRDF data handling and visualisation" and meetings will be chaired during CIE events, and using the internet platform provided by CIE collaboration tool. The output from this activity to A2.3.6 will be available by month 32 (December 2019).	Aalto, UA

- **Deadlines: M10 (Feb. 2018) & M32 (Dec. 2019)**
  - **CIE training?**
  - **How long?**



WP2: activities 2.1



WP2: activities 2.1

Activity number	Activity description	Partners (Lead in red)
A2.1.4	UA, with input from CNAM, will collect existing proposals of file format for BRDF measurements e.g. Radiant Zemax. UA and CNAM will build on their knowledge of existing file formats and will contact members of the CIE-TC2-85 and the RF created in A2.1.3 to obtain feedback on this. The study will identify representative files from the three main communities handling BRDF data (BRDF providers, BRDF models, BRDF rendering).	UA, CNAM

- **Deadline: M15 (Jul. 2018)**
- **BRDF communities? Feedback by a survey? When?**
  - **First list: TAC – X-Rite, AKZNC, Arnold, ERC-Grant Zaragoza, etc.**

WP2: activities 2.1

Activity number	Activity description	Partners (Lead in red)
A2.1.5	Using input from A2.1.4, UA will make a first proposal of a universal BRDF file format that will be discussed and agreed within the RF. The RF is a new tool at CIE and the discussion within this forum will be agreed upon its start.	UA

- Deadline: M17 (Sept. 2018)
- Universal BRDF file format:
  - BiRD preferences?
  - Contingencies: how we can be pro-active? RF
    - rejection from BRDF communities …

WP2: activities 2.1

Activity number	Activity description	Partners (Lead in red)
A2.1.6	Using input from A2.1.5, UA will write a technical note describing the arrangement of the universal BRDF file format(s) (i.e. the way the data will be organised) which has been accepted by the RF.	UA

- **Deadline: M18 (Oct. 2018)**
  - **First draft before June 2018**
- **Only a technical note?**
  - **Different doc lengths for different BRDF communities?**
    - **Justification of the consensual universal BRDF file format**

WP2: activities 2.2

- **Appearance descriptors from BRDF data and visualization modes**

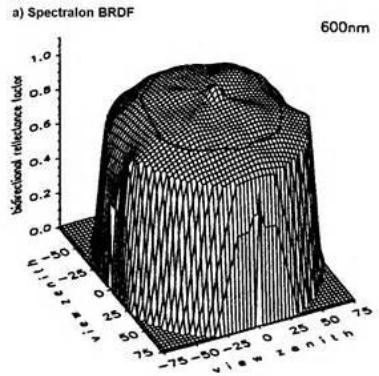
Activity number	Activity description	Partners (Lead in red)
A2.2.1	UA and Aalto will review the state of the art in terms of existing commercial colour management software for colour quality control of surface appearance. For this, UA will contact potential stakeholders of this project e.g. ColorCare® by BASF Coatings, Smart-Lab by BYK-Gardner, Total Appearance Capture by X-Rite, including those in the stakeholder committee established in A5.1.1.	UA, Aalto

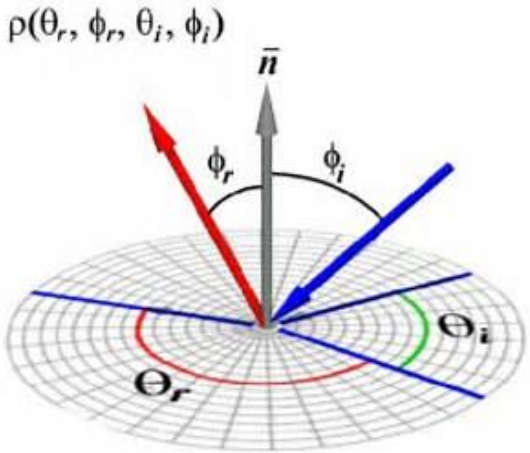
- **Deadline: M13 (May 2018)**
  - **Additional software: ColorPortal® by PPG, Office Color Science, etc.**

WP2: activities 2.2

Activity number	Activity description	Partners (Lead in red)
A2.2.2	Using input from A2.2.1, Aalto will develop an open source code to plot and to compare BRDF in polar mode, using X, Y, Z representations with inputs from UA. The code will be tested with data from A1.2.1, A1.2.2, A1.2.3 and A1.2.4, and data obtained in IND52 xDReflect.	Aalto, UA

- Deadline: M16 (Aug 2018)
- XYZ representations with UA inputs?
  - Aalto clarifies now.

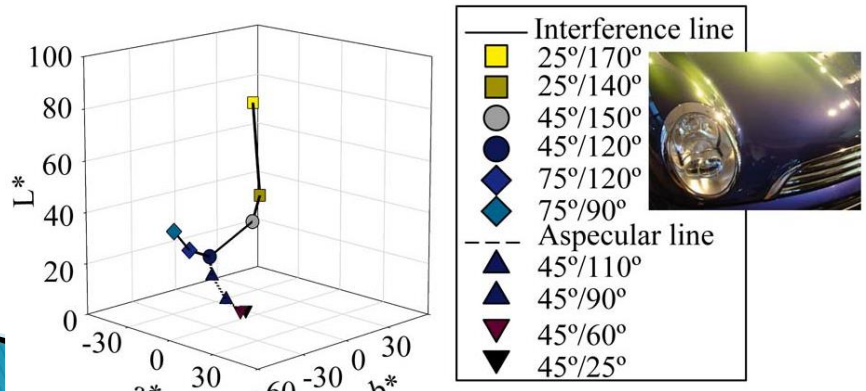


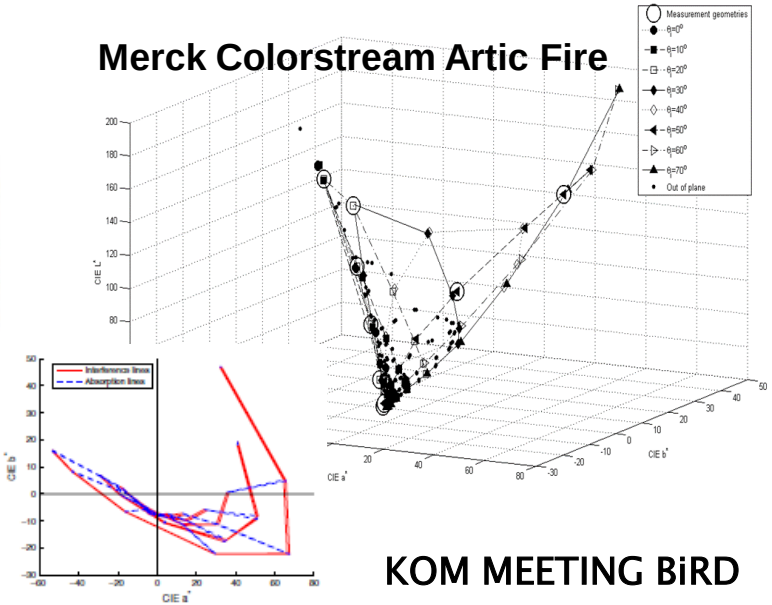


WP2: activities 2.2

Activity number	Activity description	Partners (Lead in red)
A2.2.3	**Aalto, with support from UA, will develop an open source code to plot and compare the colour travel, an appearance descriptor, in CIELAB space, a visualisation mode of BRDF data. The code will be tested with data from A1.2.1, A1.2.2, A1.2.3 and A1.2.4, and obtained in IND52 xDReflect.**	**Aalto, UA**

- **Deadline: M19 (Nov 2018)**

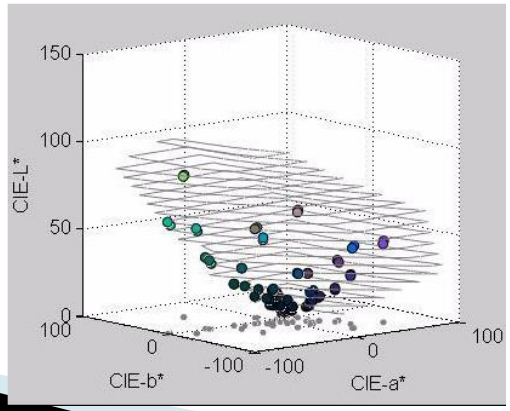


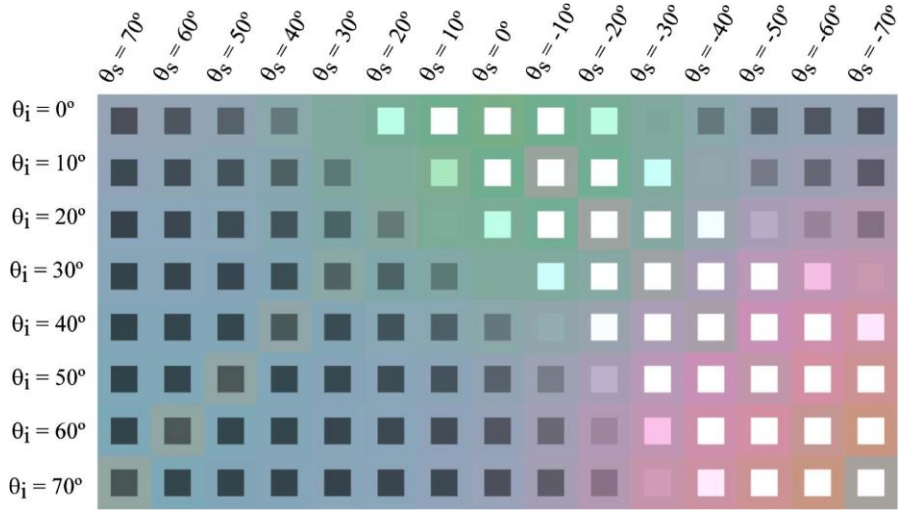


WP2: activities 2.2

Activity number	Activity description	Partners (Lead in red)
A2.2.4	UA, with support of CSIC, will develop an open source code to plot BRDF measurement in a visualisation mode such as sRGB space or multi-primary encoding space (theoretical or real) according to the colour gamut limitations of commercial displays. The code will be tested with data from A1.2.1, A1.2.2, A1.2.3 and A1.2.4, and data obtained in IND52 xDReflect.	UA, CSIC

- **Deadline: M22 (Feb 2019)**

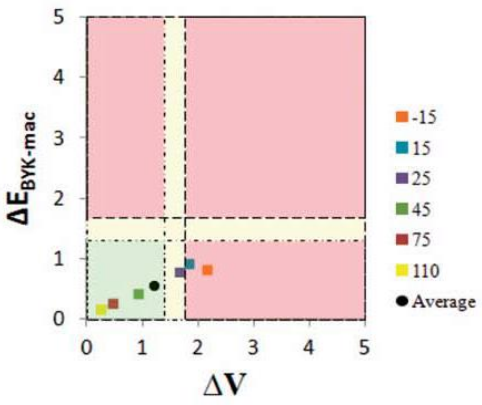


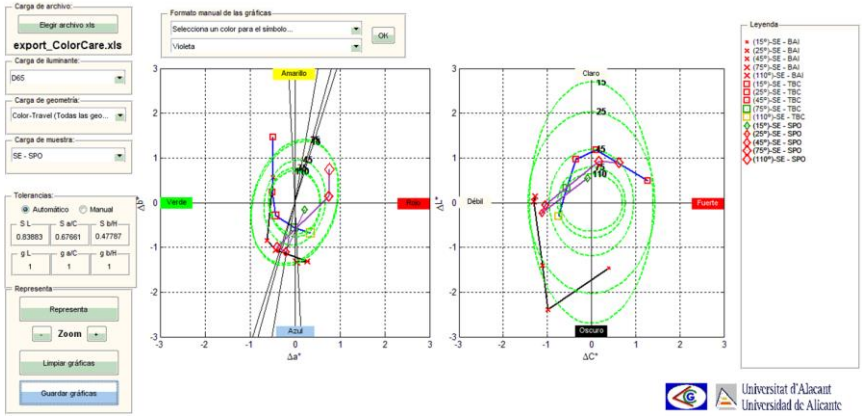


WP2: activities 2.2

Activity number	Activity description	Partners (Lead in red)
A2.2.5	UA will develop an open code source that will compute the colour difference between two sets of goniochromatic BRDF data. The code will include appearance descriptors linked to colour tolerance e.g. colour travel and alert for colour tolerance, specified by the user that will be useful for quality control of goniochromatic samples. The code will be tested with data from A1.2.3 and A1.2.4, and other data obtained in IND52 xDReflect.	UA

- **Deadline: M25 (Jun 2019)**

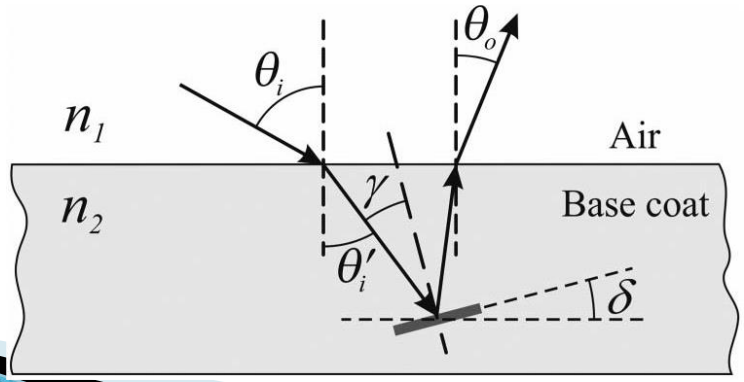


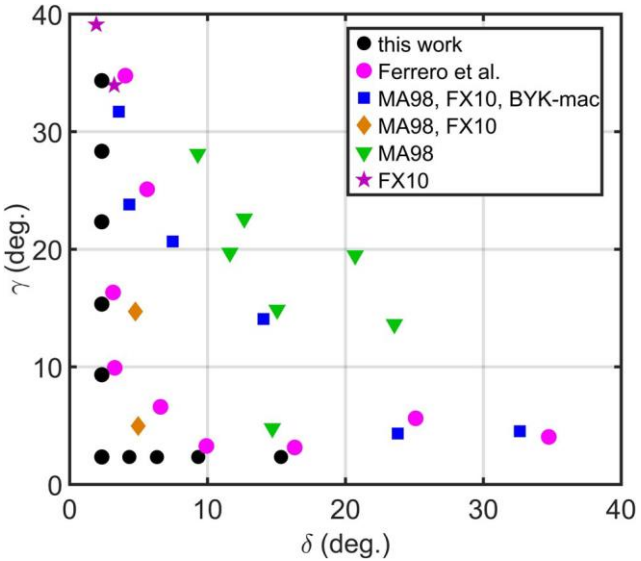


WP2: activities 2.2

Activity number	Activity description	Partners (Lead in red)
A2.2.6	PTB, in collaboration with CSIC, Aalto and UA, will test the codes developed in A2.2.2, A2.2.3 and A2.2.4 using BRDF measurements from xDReflect and the sampling strategy from A1.5.4. An iterative process will be used between PTB and the code developers (Aalto, UA, CSIC) to test and validate codes.	PTB, UA, CSIC, Aalto

- **Deadline: M31 (Nov 2019)**





WP2: activities 2.3

- **BRDF visualization and management applet**

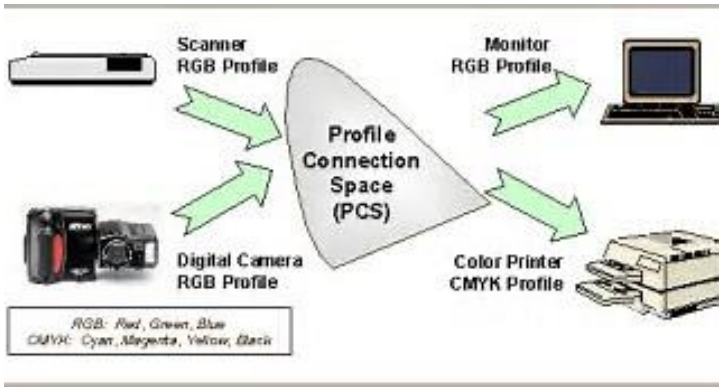
Activity number		Partners (Lead in red)
A2.3.1	UA, with input of Aalto, CNAM, CSIC and PTB will seek input from stakeholders and rendering software designers, including those in the stakeholder committee (A5.1.1) on the file format used in commercial devices. Input will be sought through email and discussions at conferences, technical committee meetings or project meetings.	UA, Aalto, CNAM, CSIC, PTB

- **Deadline: M13 (May 2018)**
  - **ASTM E2194 & ASTME2539, etc.**
  - **Blender, Python Imaging Library, OSL, etc.**

WP2: activities 2.3

Activity number	Activity description	Partners (Lead in red)
A2.3.2	UA will develop an initial version of the applet and make it available to stakeholders of this project, including those in the stakeholder committee (A5.1.1), to test. This applet will i) enable to upload the BRDF file format identified in A2.3.1 and convert it into the universal BRDF file format; discussed with the RF in A2.1.5 ii) perform the final conversion and downloading, always from the universal format for any device/software dependent BRDF file; and iii) include the open source codes developed in A2.2.2, A2.2.3, A2.2.4 and A2.2.5 and provide them in a user friendly software.	UA

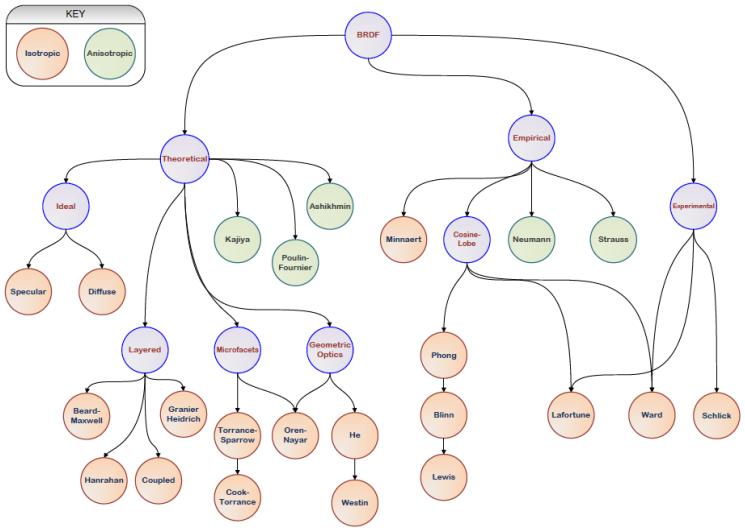
- **Deadline: M26 (Jun 2019)**
  - **ICC PCS = BiRD BRDF**



WP2: activities 2.3

Activity number	Activity description	Partners (Lead in red)
A2.3.3	UA will gather feedback of users that were provided with the initial version of the applet (A2.3.2), when comparing for example real BRDF (full or estimated) vs. computational BRDF models. UA, with support from CSIC and PTB, will improve the applet and the universal file format, as necessary and building on the feedback obtained.	UA, CSIC, PTB

- **Deadline: M30 (Oct 2019)**
  - **Model survey for feedback?**



An Overview of BRDF Models

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WP2: activities 2.3

Activity number	Activity description	Partners (Lead in red)
A2.3.4	UA will write a basic handbook of utilisation and applet maintenance. An initial version of this handbook will be made available together with the applet from A2.3.2 at month 26 (June 2019). Upon improvement of the applet in A2.3.3, an updated version of the handbook will be made available with the applet.	UA

- **Deadlines: M26 (Jun 2019), M31 (Oct 2019)**
  - **CIE template for basic handbook?**

WP2: activities 2.3

Activity number	Activity description	Partners (Lead in red)
A2.3.5	CMI will announce and promote on the website the creation of the BRDF visualisation and management applet, which will also be promoted at CIE TC2-85 and EURAMET TC-PR meetings. The applet will be open access and free for download from the project website.	CMI

- **Deadline: M32 (Dec 2019)**
  - **Website design? As a blog (for receiving feedback)?**

WP2: activities 2.3

pythonware.com/products/pil

Python Imaging Library (PIL)

The **Python Imaging Library (PIL)** adds image processing capabilities to your Python interpreter. This library supports many file formats, and provides powerful image processing and graphics capabilities.

Status

The current free version is PIL 1.1.7. This release supports Python 1.5.2 and newer, including 2.5 and 2.6. A version for 3.X will be released later.

Support

Free Support: If you don't have a support contract, please send your question to the Python Image SIG mailing list. The same applies for bug reports and patches.

You can join the Image SIG via python.org's subscription page, or by sending a mail to image-sig-request@python.org. Put *subscribe* in the message body to automatically subscribe to the list, or *help* to get additional information.

You can also ask on the Python mailing list, *python-list@python.org*, or the newsgroup *comp.lang.python*. **Please don't send support questions to PythonWare addresses**.

Downloads

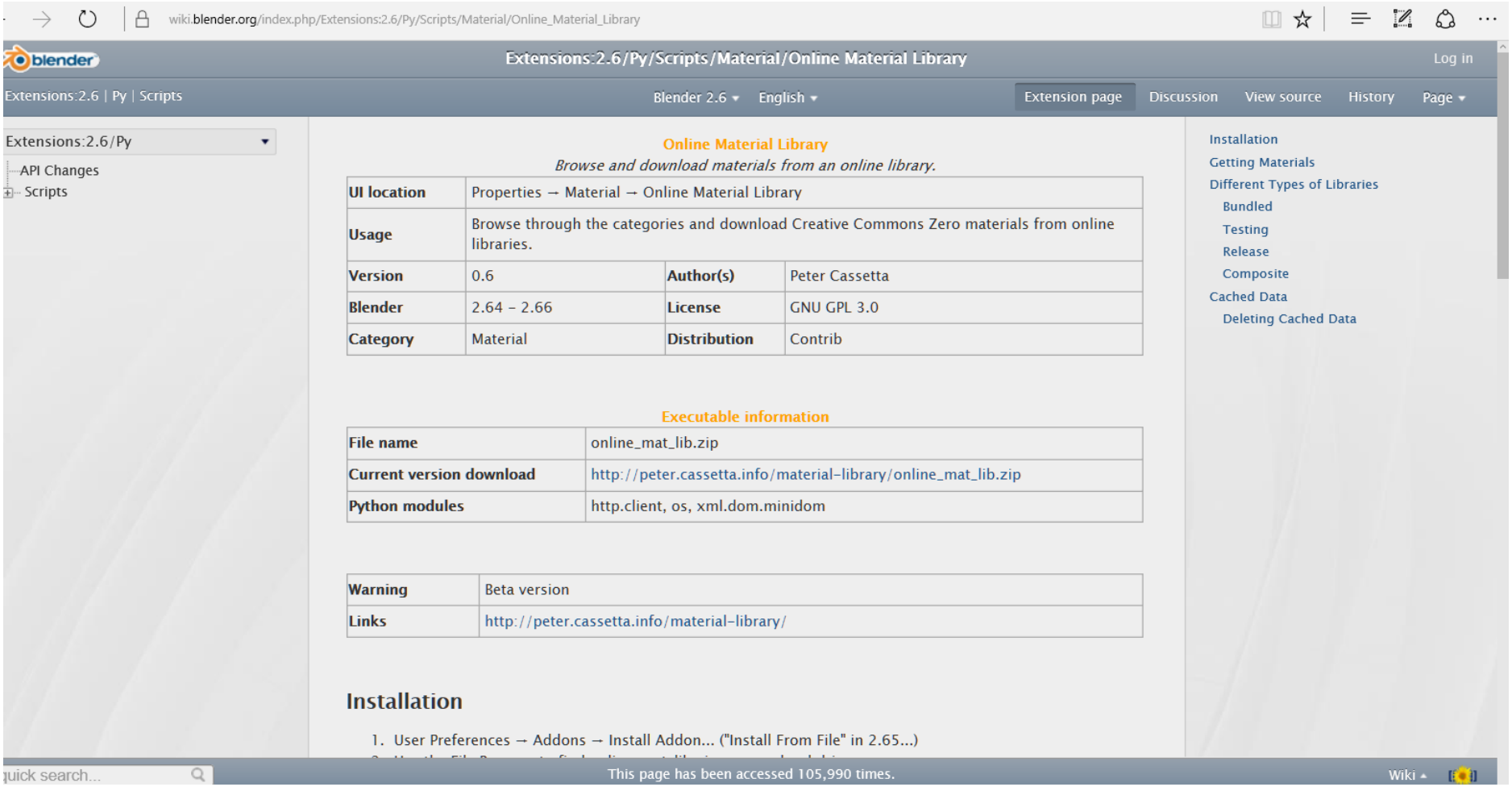
The following downloads are currently available:

PIL 1.1.7

- **Python Imaging Library 1.1.7 Source Kit** (all platforms) (November 15, 2009)
- **Python Imaging Library 1.1.7 for Python 2.4** (Windows only)
- **Python Imaging Library 1.1.7 for Python 2.5** (Windows only)
- **Python Imaging Library 1.1.7 for Python 2.6** (Windows only)
- **Python Imaging Library 1.1.7 for Python 2.7** (Windows only)

Additional downloads may be found here.

WP2: activities 2.3



wiki.blender.org/index.php/Extensions:2.6/Py/Scripts/Material/Online_Material_Library

Extensions:2.6/Py/Scripts/Material/Online Material Library

Log in

Extensions:2.6 | Py | Scripts

Blender 2.6 | English | Extension page | Discussion | View source | History | Page

Extensions:2.6/Py

- API Changes
- Scripts

Online Material Library

Browse and download materials from an online library.

UI location	Properties → Material → Online Material Library		
Usage	Browse through the categories and download Creative Commons Zero materials from online libraries.		
Version	0.6	**Author(s)**	Peter Cassetta
Blender	2.64 – 2.66	**License**	GNU GPL 3.0
Category	Material	**Distribution**	Contrib

Executable information

File name	online_mat_lib.zip
Current version download	http://peter.cassetta.info/material-library/online_mat_lib.zip
Python modules	http.client, os, xml.dom.minidom

Warning	Beta version
Links	http://peter.cassetta.info/material-library/

Installation

1. User Preferences → Addons → Install Addon... ("Install From File" in 2.65...)

Installation
Getting Materials
Different Types of Libraries
Bundled
Testing
Release
Composite
Cached Data
Deleting Cached Data

quick search...

This page has been accessed 105,990 times.

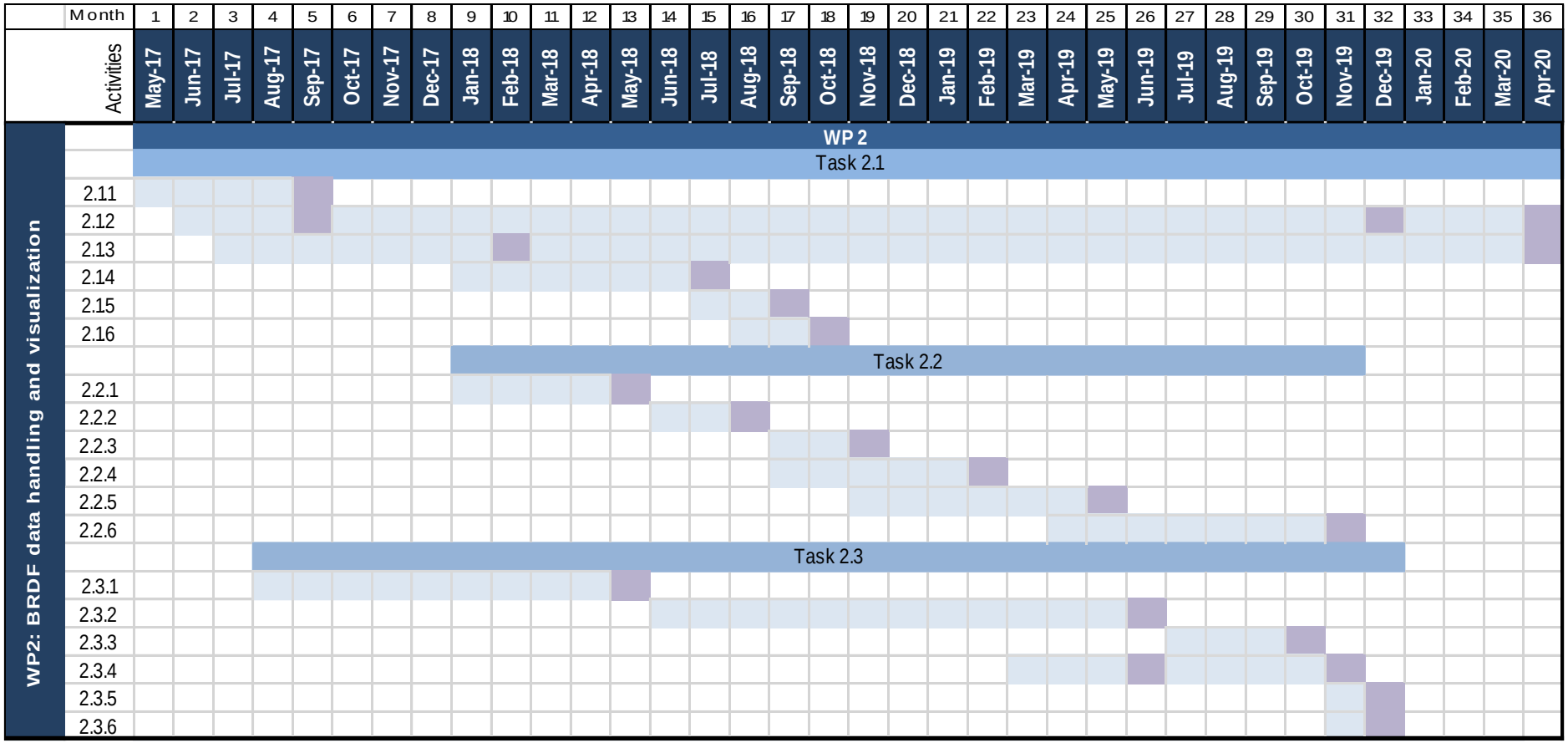
Wiki

WP2: activities 2.3

Activity number	Activity description	Partners (Lead in red)
A2.3.6	Using input from A2.11-A2.1.5, A2.2.1-A2.2.6, and A2.3.1-A2.3.4, UA, with support from Aalto, CSIC and PTB, will write recommendations for BRDF data handling and visualisation and send it to CNAM. Once the recommendations has been approved by the consortium, the coordinator on behalf of the other partners will submit the recommendations to EURAMET as D3 'Recommendations for BRDF data handling and visualisation, including data format, basic visualisation modes, parametrisation, conversion to visual appearance descriptors used in industry, and guidance on the utilisation and maintenance of a novel developed applet'. The recommendations will be disseminated to CIE TC2-85 and stakeholders in A5.1.7.	UA, Aalto, CSIC, CNAM, PTB

- **Deadline: M32 (Dec 2019)**

WP2: chronogram



WP2: deliverables

Relevant objective	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in red)	Delivery date
2	D3	Recommendations for BRDF data handling and visualisation, including data format, basic visualisation modes, parametrisation, conversion to visual appearance descriptors used in industry, and guidance on the utilisation and maintenance of a novel developed applet	Recommen-dation	UA, Aalto, CSIC, PTB	Dec 2019 (M32)

WP2: sci./tech. risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
A2.1.1: CIE rejects the creation of the Research Forum.	Likelihood without mitigation: Low Impact: No Research Forum is established to facilitate discussion on a universal BRDF data file. Likelihood after mitigation: Very low	Aalto will discuss the proper strategy for the RF with other project partners at project meetings and international conferences.	Open a public forum for discussion on the project website and report results at CIE Division 2 meetings as appropriate.
A2.1.5: There is no consensus for the universal BRDF file format in the RF.	Likelihood without mitigation: Low Impact: Delay in activities linked to this work. Likelihood after mitigation: Very low	UA will propose at least two or three universal BRDF file formats marking their pros and cons taking into account the preferences from the scientific and industry communities.	If no consensus is reached, the partners will keep the remaining file format proposals and will submit the proposals to the RF or CIE Division2 (in the case that the creation of the RF is not accepted in A2.1.1).

WP2: sci./tech. risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
A2.2.4 and A2.2.6 : Many colours from BRDF data are not colorimetrically reproduced in the current display technologies (CRT, LCD, plasma, LED, OLED, QD, etc.)	Likelihood without mitigation: Medium Impact: Partial visualisation of the colour gamut of any goniochromatic sample. Likelihood after mitigation: Medium	There is no possible mitigation for this risk as the consortium does not control the display technology. However this is a fast moving field and as the technology display technology improve, the risk decreases.	Propose alternatives based on gamut mapping techniques used in Graphic Arts, to use digital colours in displays with close colour appearance, either by hue, chroma or lightness balance. Prepare in the corresponding activity a comparative of colour gamut limitations for the current display technologies using the same examples of gonio-apparent samples, showing the true colour distances between the replicated colour (perceptible and feasible on display) and true colour by BRDF colorimetry.

WP2: sci./tech. risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
A2.3.2: The process to convert BRDF file into the universal format, or vice versa is not completely efficient for most of the cases.	Likelihood without mitigation: Medium Impact: Decrease of expectations about the universal BRDF file format. Likelihood after mitigation: Low	UA will contact internal software professional programmers to work on the BRDF file format and solve the problem.	UA will look for support from i) the RF forum (or CIE Division 2), and ii) the collaboration with other external experts e.g. academics. (That is, make this a collaborative challenge via Internet, as past and recognised internet projects as Wikipedia, OpenOffice, R, etc.) The corresponding deliverable will include a list of feasible and not available conversions, and in both directions.

WP2: sci./tech. risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
A2.3.2 The user experiences of the BRDF visualisation and management applet are not satisfactory, and/or are very scarce.	Likelihood without mitigation: Low Impact: Delay to initiate and complete the activities of this task linked to this work. Likelihood after mitigation: Very low	Give the collaborators enough time and propose virtual meetings (by Skype, Webex, etc.) to explain the applet and its functions, in addition to the handbook of utilisation (A2.3.4) for end-user transfers. Distribute this applet freely, which will be completely auto-executable in any operative systems (Apple, Windows, etc.) to other communities (industries not initially listed as stakeholders in this project, University research groups, etc.) to test it, and receive additional feedback.	Establish a deadline to receive feedback from the collaborators in order to collect all recommendations to improve the original (beta) applet version. Establish a short period from the beta version to the version ready to be publicly launched in A2.3.5.

WP2: management risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
Insufficient collaboration Collaboration between the partners delivering to the work packages is insufficient due to lack of communication between the partners or for other reasons.	Likelihood without mitigation: Low Impact: Project deliverables will be delayed. Likelihood after mitigation: Very low	The partners have collaborated previously in another project. Good work relationships have been established. Regular project meetings will be held ensuring a high level of collaboration and maintaining good relationships between the partners.	The coordinator and the WP leaders will work as much as possible to minimise this risk as far as possible. However, small delays in the deliverables might still be unavoidable.

WP2: management risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
Intellectual property rights Problems dealing with Intellectual Property (IP) ownership and/or exploitation might occur and could be a source of potential conflict.	Likelihood without mitigation: Low Impact: Dispute within the consortium over intellectual property rights and over possible delay of publications of project results. Likelihood after mitigation: Low	All partners will sign the grant agreement and consortium agreement, which includes IP clauses.	In the event of disagreement between the partners, the competent Belgian (or: German) national court has jurisdiction.

WP2: management risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
Inter-dependencies between technical activities and tasks are too complex.	Likelihood without mitigation: Medium Impact: Tasks are delayed or it is not possible to deliver them. Likelihood after mitigation: Low	Technical meetings run by WP leaders have been scheduled to ensure proper sharing of knowledge. The interdependencies between tasks will be considered at meetings to ensure that this is addressed properly in the planning of the work. The technical WPs will be closely managed by their WP leaders to ensure that they deliver their own outputs.	In most cases, activities on the critical path have some overlap in time and thus a delay in the output of one deliverable does not necessarily cause an immediate delay in another.

WP2: management risks

Risk (description)	Likelihood and impact of occurrence	Mitigation i.e. what the consortium will do to decrease the likelihood of the risk occurring	Contingency i.e. what the consortium will do if despite the mitigation the risk still occurs
Complexity of managing a large consortium.	Likelihood without mitigation: Medium Impact: Failure to fully cooperate or communicate effectively within the consortium could endanger efficient delivery of the project. Likelihood after mitigation: Low	The partners are all experienced with complex multinational projects. Many have previously developed close relationships through collaborating within other European consortia. Regular communication and feedback will ensure that potential problems are identified early and that all partners are clear on their roles.	WP leaders will play an important role in flagging up potential problems to the coordinator and the project management board, who will then decide on the best course of action to take. If necessary, work will be reassigned to an alternative partner, or parts of the work re-scoped in agreement with EURAMET.

WP2: conclusions

- **We have a challenging work package, whose main milestones are:**
  - **Research Forum set-up with well-representative members from all BRDF communities**
    - **reach a consensus for the universal BRDF file format**
  - **Useful BRDF visualization and management applet**
    - **successful dissemination for a worldwide acceptation**
  - **D3: Recommendations and applet + handbook**

Universitat d'Alacant
Universidad de Alicante

le cnam

Paris, 4th – 5th May 2017

Kick-Off Meeting

BiRD: WP2

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verdu@ua.es

BiRD
Bidirectional Reflectance Definitions
JRP 16NRM08

Color & Vision Group
http://web.ua.es/en/gvc