LIME TOOLBOX REQUIREMENT DOCUMENT

ABSTRACT

This document provides the LIME Toolbox requirement description to be agreed with ESA.

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LUNAR IRRADIANCE MODEL OF ESA

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Signatures and version history

	Name	Organisation	Date
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1 Introduction

1.2 Purpose and Scope

This document provides the critical review of the LIME Toolbox requirements as provided in the Statement of Work, that need to be agreed with ESA in the KO+2 project meeting of the ESA-funded project “Improving the Lunar Irradiance Model of ESA”.

1.3 Applicable and reference documents

1.3.1 Applicable Documents

The following applicable documents are those specification, standards, criteria, etc. used to define the requirements of the LIME toolbox.

Number	Reference
[AD0]	ESA-EOPG-EOPGMQ-SOW-24. Improving the Lunar Irradiance Model of ESA.

1.4 Glossary

1.4.1 Abbreviations

Abbreviation	Stands For	Notes
ASD	Analytical Spectral Devices	Instrument manufacturer
Cimel	(Not an abbreviation)	Instrument manufacturer, also used as shorthand for instrument itself
EO	Earth Observation	
ESA	European Space Agency	Project customer
FOV	Field of View	
GIRO	GSICS Implementation of the ROLO Model	
GSICS	Global Space Based Inter-calibration System	
GUI	Graphical User Interface	
KO	Kick-off meeting	
LIME	Lunar Irradiance Model of ESA	
NPL	National Physical Laboratory	Project partner
ROLO	RObotic Lunar Observatory	
TBX	Toolbox	
TOA	Top of Atmosphere	
UVa	University of Valladolid	Project partner
VITO	Vlaamse Instelling voor Technologisch Onderzoek; Flemish Institute for Technological Research	Project partner
SoW	Statement of Work	

2 LIME Toolbox requirement review

The LIME TBX requirements were described in Annex 1 of the SoW (AD0). According to the description of Task 2: Development of the LIME toolbox, the list of requirements needs to be critically reviewed by the consortium and then compiled in a LIME TBX requirement document to be agreed with ESA.

This is the first step in the elaboration of a software tool –the LIME TBX– that will allow to easily run LIME and compare its outputs to remote sensing measurements. For this purpose, the requirements were classified as Critical (C), Major (M) and Minor(m), indicating mandatory, 'should have' and 'nice to have' categorization of the requirement list. Table 1 shows this classification.

Table 1. List of LIME Toolbox requirements

Requirement list	Category	Comments
1. Functionalities		
1.1. General		
• Allow users to simulate lunar observations for any observer position around the Earth and at any time.	C	
• Allow users to simulate lunar observations from any satellite position for which an orbital scenario file is provided by a user in EOCFI compatible format	C	
• Allow users to simulate lunar observation for any observer/solar selenographic latitude and longitude (thus bypassing the need for their computation from the position/time of the observer).	C	
• Allow users to simulate the lunar observations for any user defined instrument spectral response	C	
• Allow users to simulate lunar observation for a single observation (via the GUI) or for a time series of observations (via an input file)	C	
• Allow performing comparisons of lunar observations from remote sensing instrument (pre-stored in a GLOD format) to the LIME model output.	C	
• Perform automatic updates of the LIME coefficients (to be stored on a dedicated repository).	M	Clear versioning of the LIME coefficients will be added. Users will be able to select version.
• Be to the largest extent platform/operating system independent.	m	Python already provides this functionality.
• Run at least under Windows / mac OS / Linux operating systems.	m	Python already provides this functionality.
• Be to the largest extent a self-installing SW package	M	The GLOD database is too large and needs to be kept separate from the TBX.
1.2. Graphical User Interface (GUI)		
• Allow users to enter simulation inputs (observation position and time or a files containing these) and to visualise the associated LIME outputs	C	
• Allow users to select via the GUI an ESA satellite for which lunar observation are to be simulated. This shall include ENVISAT, Proba-V, S2, S3, FLEX.	C	

• Allow users to either choose between default satellite spectral band SRF or select a user defined SRF (via a user generated SRF file).	C	
• Allow users to visualise comparisons of remote sensing lunar observations (stored in GLOD format) to the LIME outputs	C	
• The comparison plots shall provide: relative differences between measured and modelled lunar irradiance/reflectance vs. time and vs. lunar phase angle.	C	
• The comparison plots shall display statistical indicators (mean relative difference, standard deviation of the mean relative difference, temporal trend if applicable, number of comparison samples, etc…)	C	
• The visualisation of the user defined spectral response used for the spectral integration of the LIME output into a sensor spectral band.	C	
• Allow to export plots to .jpg or .pdf from the GUI	C	
1.3. Simulation inputs		
• The LIME TBX shall read the database of lunar observations formatted in GLOD format	C	
1.4. Simulation outputs		
• The LIME TBX shall output simulated lunar disk irradiance or reflectance in the spectral range 400 nm to 2500 nm	C	
• The LIME TBX shall output the simulated lunar disk degree of polarisation in the spectral range 400 nm to 2500 nm	C	
• The LIME TBX shall output simulated lunar irradiance or reflectance associated uncertainty	C	
• The LIME TBX shall output simulated lunar degree of polarisation associated uncertainty	M	Only an approximated uncertainty estimate will be provided for polarization. Uncertainty propagation for a user defined instrument response function is not straightforward when combined with polarization sensitivity of instrument.
• The LIME version number shall be visible on all outputs (plots/files) of the TBX	C	
• The LIME simulated output shall be exported to the GLOD format files	C	
2. Coding and libraries		
• The LIME TBX shall use the EOCFI as orbit propagator and to derive satellite orbital positions	M	EOCFI will be used although the SPICE library will also be explored, as it is the current library used in LIME.
• The LIME TBX shall be to the largest extent developed in Python	C	

3. Accessibility		
• The LIME TBX code shall be available on a password protected web repository allowing versioning of the software (e.g. github).	C	

In practice, all requirements marked as critical are accepted as such by the consortium. For the others, some comments are provided in order to facilitate the discussion with ESA during KO+2 project meeting.