SO/PHI

Polarimetric and Helioseismic Imager for Solar Orbiter

SOPHISM DATA PACKAGE

reference	SOL-PHI-GACE-DE3200-DP-1
issue	3
revision	2
release date	2017-04-26
prepared by	Julián Blanco Rodríguez
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CHANGE LOG

REASON FOR CHANGE	ISSUE	REVISION	DATE
First Issue (Issues 1 and 2, blank)	3	0	2015-01-15
Update of several routines, introduction of new ones	3	1	2016-07-08
New inversion module, FOV prefilter, update of routines	3	2	2017-04-26

CHANGE RECORD

changes published in issue: 3 revision: 2

REASON FOR CHANGE	SECTION(S)	PAGE(S)
Update of several routines, introduction of new ones (see table in Sect. 2)	2, Appendix	5-6, 8-35
New inversion module, FOV prefilter, update of several routines (see table in Sect. 2)	2, Appendix	5-6, 8-35

TABLE OF CONTENTS

1. GENERAL

Description of contents in the SOPHISM software simulator compressed file (SOL-PHI-GACE-DE3200-DP-1_3_2=SOPHISM Data Package.zip) as well as versions and dates of last modification of the different files.

For a general description of the simulator and its guidelines, see [NR02]. For explanations about how to operate the simulator and the meanings of the settings for the simulations, see [IR01].

When performing modifications to the simulator programs, please refer them to the responsible and coordinator, Julián Blanco (e-mail: julian.blanco@uv.es).

2. CONTENT OF TAR ARCHIVE

See Appendix for details of modifications on each version of the routines.

- Folder '**code**'

Filename	Version	Modification Date	Updated?
sophism.pro	5_0	April 2017	Yes
sophism_init_aux.pro	1_4	April 2017	Yes
sophism_loadascii.pro	2_8	July 2015	--
sophism_aux.pro	1_1	March 2013	--
sophism_input.pro	3_1	April 2013	--
sophism_input_redim.pro	2_1	April 2013	--
sophism_jitter.pro	3_2	June 2016	--
sophism_jitter_tpfilt.pro	1_1	February 2013	--
sophism_jitter_atten.pro	1_1	February 2013	--
sophism_polmeas.pro	3_41	April 2017	Yes
sophism_polmeas_modscheme.pro	4_5	March 2017	Yes
sophism_polmeas_modscheme_retardance.pro	2_51	November 2016	Yes
sophism_polmeas_birefringence.pro	1_0	February 2016	--
sophism_polmeas_birefringence_model.pro	1_1	July 2016	Yes
sophism_linbo.pro	3_1	March 2017	Yes
sophism_linbo_lambint.pro	1_0	November 2012	--
sophism_linbo_geometry.pro	2_0	September 2012	--
sophism_otf.pro	3_6	April 2017	Yes
sophism_papo.pro	2_7	April 2017	Yes
sophism_fpa.pro	2_99	April 2017	Yes
sophism_accu.pro	2_4	May 2015	--
sophism_demod.pro	2_31	April 2017	Yes
sophism_demod_adhoc.pro	1_2	February 2016	--
sophism_inversion.pro	2_1	November 2014	Obsolete
sophism_inversion_classical.pro	2_0	July 2014	Obsolete

sophism_inversion_milos.pro	2_0	July 2014	Obsolete
sophism_inversion.pro	1_1	April 2017	New
sophism_compression.pro	1_4	June 2016	--
sophism_report.pro	3_1	February 2016	Yes
DataComp.exe	0_9	April 2015	Yes

- Folder **'docum'**

Filename	**Version**	**Modification Date**
SOL-PHI-GACE-DE3200-DP-1_3_2=SOPHISM Data Package.doc	3_2	April 2017

- Folder '**settings**'
  - settings_sophism.sav
  - sophism_ascii_examp.txt

Another group of files, not directly related to SOPHISM but used in it, are also included in the package:

- Folder **'code/aux'**:
  - avg.pro
  - check_fits.pro
  - check_rpupil.pro
  - checksum32.pro
  - crosscorr_c.pro
  - daycnv.pro **(Added March 2017)**
  - device.pro
  - fact.pro
  - fft_shift.pro
  - fits_add_checksum.pro
  - fits_ascii_encode.pro
  - frac_shift.pro
  - fxaddpar.pro
  - fxmove.pro
  - fxparpos.pro
  - fxpar.pro
  - fxposit.pro
  - get_date.pro
  - gettok.pro
  - headfits.pro
  - host_to_ieee.pro
  - is_ieee_big.pro
  - minmax.pro
  - mirror.pro
  - mkhdr.pro
  - mrd_hread.pro
  - mrd_skip.pro
  - n_bytes.pro
  - odd.pro
  - otfunc.pro
  - radius_aper2.pro
  - readfits.pro
  - resize.pro
  - rota.pro

- sign.pro
- sxaddpar.pro
- sxdelpar.pro
- sxpar.pro
- theta.pro
- tvframe.pro
- valid_num.pro
- writefits.pro
- zernike2.pro
- zernike_mn.pro

• Folder **'data'**:
- fts6173.sav
- hrew_zernikes.txt

• Folder '**cmilos-master'** (Ver 0.9, 2015)

3. DOCUMENT REFERENCES

3.1. NORMATIVE REFERENCES

REF	TITLE	DOC-REFERENCE	ISSUE	REVISION	REL-DATE
NR01	EID-B	SOL-PHI-MPS-MN1400-IF-2	3	0	2015-11-18
NR02	SOPHISM Development Plan	SOL-PHI-GACE-DE3100-PL-1	1	1	2014-12-20

3.2. INFORMATIVE REFERENCES

REF	TITLE	DOC-REFERENCE	ISSUE	REVISION	REL-DATE
IR01	SOPHISM User Manual	SOL-PHI-GACE-DE3200-MA-1	1	0	2015-11-20
IR02	EID-A	SOL.EST.RCD.0050	5	0	2015-03-23

4. ACRONYMS

FOV	Field of View
FWHM	Full Width at Half Maximum
IMaX	Image Magnetograph eXperiment
ISS	Image Stabilization System
LCVR	Liquid Crystal Variable Retarder
OTF	Optical Transfer Function
PSF	Point Spread Function
SO	Solar Orbiter
SO/PHI	Polarimetric and Helioseismic Imager for Solar Orbiter
SOPHISM	SO/PHI simulator

APPENDIX: ROUTINES DESCRIPTION AND MODIFICATION HISTORY

File name: sophism

Version: 5_0 **Date**: March 2017

Description
Main routine for the SOPHISM simulator. Sets default values for the variables. Opens a widget for changing those values or selecting previously saved settings. Selection of modules to be run on the simulation, input data files, filenames of outputs.

Changes from previous versions:

J. Blanco. 2011. Creation of widgets and default parameters
J. Blanco. 2012.
J. Blanco. Nov 2012. v2_1. Added Inversion and Report modules. Added 'tuning jittering' in etalon.
J. Blanco. Dec 2012. v2_2. Added verbose option. Added options to report module to force report in modules not selected in the run, in case they were run before and data are present.
J. Blanco. Dec 2012. v2_3. Added input fields for LCVR errors values
J. Blanco. Jan 2013. v2_4. Check for existing output directory. Demodulation parameters split to mark there the adhoc option. Included file selection for input data, fringes, prefilter loading
J. Blanco. Feb 2013. v2_5. Transmittance ready, filcuth for low frequency cutoff Hinode filter, issunder for ISS underperformance. Check if info.saves variable ends in /. When recalculating ntim=tobs/tsamp, make round or may cause problems. Added nogui option. Allow no dark and no photon noise.
J. Blanco. Apr 2013. v2_6. Corrected bug when preparing voltarr. Also with numprogmas. Also in defocus conversion from mm to zernike coeff. in rad (missing 1e-7)
J. Blanco. May 2013. v2_7. Added variable obsset to replicate the observation run.
J. Blanco. Oct 2013. v2_8. Corrected bug from obsset.
J. Blanco. Jan 2014. v3_0. Option for discarding whole frames (not just the samples of the tdeath). Option to consider discarding when changing etalon position. Option to enable or disable the rearrange of Stokes dimension (I,V,Q,U--I,Q,U,V) for modulation. Corrected bug for obsset.
J. Blanco. May 2014. v4_0. Added compression module to list and settings. Added inversion continuum setting. Readout (frame) time as modifiable setting.
J. Blanco. Jun 2014. v4_1. Added etalon speed for calculating discarded frames. Split FPA settings in two. Photon noise selection of generation, loading or nothing. Cycle repetition correction. Added flat intensity range. Keep only one element of ndeathlcvr if not running polarization module.
J. Blanco. Jul 2014. v4_2. Selection for generating/loading gain table, modified variable name.
J. Blanco. Aug 2014. v4_3. Re-organization of polarization cycles and observation sets variables and cases.
J. Blanco. Sep 2014. v4_4. Change of cycle repetition scheme to associate it to array's Stokes dimension. In case of no polarization, set cycles to 1.
J. Blanco. Oct 2014. v4_5. Update default LCVRs' retardances. Corrected bug in defocus conversion from mm to rad, adding focal length setting. Change variable name 'Wavelength dimension' to 'Wavelength extension' because it was repeated.
J. Blanco. Nov 2014. v4_6. Added hot/dead pixels generation. Added cosmic rays generator. Start option for beginning the simulation in a given sample, not from the first one (for times when simulation was cut in the middle of a module run).
J. Blanco. May 2015. v4_7. Introduced factor for flux conversion for input data, when it is not in erg/s/cm2/... Aesthetic changes in GUI, making some fields only modifiable when marking the corresponding options (e.g. start sample).
J. Blanco. Feb 2016. v4_8. Introduced birefringence settings, including distance EW-Entrance in Global.
J. Blanco. Apr 2016. v4_9. Modified fringes settings because of new way of producing them
J. Blanco. Mar 2017. v5_0. Included settings for C-Milos inversion, limited inversion FOV, and for FOV-prefilter

File name: sophism_init_aux

Version: 1_4 **Date**: April 2017

Description
Compilation of auxiliary routines

Changes from previous versions:

J. Blanco. Dec 2012. v1_0.
J. Blanco. Dec 2012. v1_1. Reorder of functions
J. Blanco. Dec 2012. v1_2. Added new functions to compile (tvframe,avg,...)
J. Blanco. Feb 2013. v1_3. New functions related with check_sum of fits files
J. Blanco. Apr 2017. v1_4. Included daycnv.pro

File name: sophism_loadascii

Version: 2_8 **Date**: July 2015

Description
Loads SOPHISM settings specified in an ASCII file. Modifies and adds some variables for the simulation run

Changes from previous versions:

J. Blanco. 2011. v0_1. First steps
J. Blanco. 2012.. v1_0. Major changes to whole routine
J. Blanco. Dec 2012. v2_0. Changes in some variables to follow main routine. Included etalon voltage error, report option to be run and modules for selection.
J. Blanco. Jan 2013. v2_1. Corrected bug 'info.routines'
J. Blanco. Feb 2013. v2_2. Corrected ntim. Included check for output folder existence. Corrected progctrl_ref
J. Blanco. May 2013. v2_3. Added variable obsset to replicate the observation run.
J. Blanco. June 2014. v2_4. Added compression module, etalon discarding, frames or samples discard scheme. Added check for etalon/polarization module in data header, for ntim purposes. Consider etalon speed for calculating discarded frames as a user setting, not fixed.
J. Blanco. Jul 2014. v2_5. Cycle repetition correction. Keep only one element of ndeathlcvr if not running polarization module.
J. Blanco. Sep 2014. v2_6. Change of cycle repetition scheme to associate it to array's Stokes dimension. In case of no polarization, set cycles to 1.
J. Blanco. Nov 2014. v2_7. Corrected bug in defocus conversion from mm to rad, adding focal length setting.
J. Blanco. Jul 2015. v2_8. Corrected bug when calculating file number, in case of starting simulation from the beginning

Filename: sophism_aux

Version: 1_1 **Date:** March 2013

Description
Auxiliary routines

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2010. v1_0. Fit into sophism
B. Loptien. Mar 2013. v1_1. Changed indgen to lindgen in sophism_make_freq for because of possible long arrays

Filename: sophism_input

Version: 3_1 **Date**: April 2013

Description
Prepares a set of synthetic Stokes images from MHD simulations. Writes the filenames in appropriate given format. Selects a subset of 1/2 or 1/4 of the wavelength dimension from each data if selected. Generates a time series if needed, by replication (when only one input data is used) or from a series of given input data (with or without temporal interpolation in the series). Replicates data and resamples to detector pixel if selected.

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2010. v1_0. Reorganization of whole process. Change to openw routines to have all data opened and interpolate them.
J. Blanco. Sept 2012. v1_1. Split subroutine sophism_input_redim to perform spatial replication and resize to detector pixel. Few other changes for further generalization of read arrays.
J. Blanco. Oct 2012. v2_0. Reformed reading/writing for time interpolation option and numfil gt 1. Should overcome idl-units limitation problem.
J. Blanco. Dec 2012. v2_1. Added printing and displaying options for talk case
J. Blanco. Jan 2013. v3_0. Reordering of resampling, replication, time series-interpolation
J. Blanco. Apr 2013. v3_1. Modified verbose lines for better display

Filename: sophism_input_redim

Version: 2_1 **Date:** April 2013

Description
Replicates datacubes in spatial dimensions and resamples to detector pixel size. Has to be done all together to save computation time and disk space. If resampling to detector is enabled, it will change the value of spatial sampling in the settings file to the new one (i.e. fpaplate)

Changes from previous versions:

J. Blanco. Sept 2012. v1_0. Split and re-organized from other subroutines
J. Blanco. Dec 2012. v1_1. Added printings for talk case
J. Blanco. Jan 2013. v1_2. Correction for reading uncompressed data
J. Blanco. Jan 2013. v2_0. Reordering of resample and replication. Modified way of procuder: not reading or writing now, just used as a step in global routine.
J. Blanco. Apr 2013. v2_1. Moved verbose line to main routine

Filename: sophism_jitter

Version: 3_2 **Date:** June 2016

Description
Generates jittering effect (different options) and applies to the data. Image Stabilization System is also possible

Changes from previous versions:

Alex Feller 2010-09-28
J. Blanco. 2011. v1_0. Adapted into sophism
J. Blanco. Oct.2012. v1_1. Change from interpolate to frac_shift when shifting the data.
J. Blanco. Dec 2012. v1_2. Plottings and printings for talk case
J. Blanco. Dec 2012. v2_0. Change frac_shitf to fft_shift for some cases. Correct mistake in renormalization
A. Feller. Feb 2013. v3_0. Modifications to normalization in Hinode filtering.
J. Blanco. Jun 2014. v3_1. Added ISSRMS parameter to header.
J. Blanco. Jun 2016. v3_2. Included start at some given sample option (nstart)

Filename: sophism_jitter_tpfilt

Version: 1_1 **Date:** February 2013

Description
Defines a jittering frequency filter from a selection of possibilities

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2011. v1_0. Minor variable changes to fit into SOPHISM structure
A. Feller. Feb 2013. v1_1. Hinode filter modifications

Filename: sophism_jitter_atten

Version: 1_1 **Date:** February 2013

Description
Generates attenuation curve from an image stabilisation system for jittering effects

Changes from previous versions:

Alex Feller 2010-12-10
J. Blanco. 2011. v1_0. Minor variable changes to fit into SOPHISM structure
J. Blanco. Feb 2013. v1_1. Added parameter to underperform ISS (implemented in sophism_2.5 but not included in header)

Filename: sophism_polmeas

Version: 3_41 **Date:** April 2017

Description
Simulates polarisation measurement, including the generation of modulation and demodulation matrixes according to a given scheme of parameters for the LCVRs and Mueller matrix of the system, the effect of temporal change of LCVRs' states and the actual modulation of the data.

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2011. v1_0. Rearrange data and variable definitions to fit into sophism. Add ‘real’ modulation case
J. Blanco. 2011. v2_0. Include change times of LCVRs and corresponding modulation. Rearrange sample variables
J. Blanco. Dec 2012. v2_1 . Add plots and prints for talk case
J. Blanco. Dec 2012. v2_2. 'Cosmetic' correction of xy.omargin
J. Blanco. Jan 2014. v3_0. Change scheme idea for modulation. Done with modulation matrixes, not 'functions' as before. Take into account possible differences of tdeaths due to tdeathetal. Flexibility for 2D modulation implementation.
J. Blanco. Jun 2014. v3_1. Added lambda dependence to modulation matrix
J. Blanco. Aug 2014. v3_2. Corrected bug in dual-beam after last modifications
J. Blanco. Sep 2014. v3_3. Change scheme for cycle repetitions
J. Blanco. Jun 2016. v3_4. Included start at some given sample option (nstart)
J. Blanco. Apr 2017. v3_41. Corrected calculations for case of no time series data

Filename: sophism_polmeas_modscheme

Version: 4_5 **Date:** March 2017

Description
Define modulation scheme, consisting of modulation and demodulation functions and the demodulation matrix

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2011. v1_0. Fit into sophism. Add 'real' modulation case and associated variables
J. Blanco. 2011. v2_0. Add change times of LCVRs and corresponding modulation. Move complete Mueller matrix calculation here to be used also for ideal. Still preliminary calculation though
J. Blanco. Jan 2013. v2_1. Added random errors to the Mueller matrix calculation. Correction of demodulation matrix for ideal case
J. Blanco. Jan 2014. v3_0. Change scheme idea for modulation. Done with modulation matrixes, not 'functions' as before. Include FOV dependence possibility for matrixes. Correct order of Mueller and modmat in products. Included 'dualmat' to make easier the production of dual-beam matrixes.
J. Blanco. Jun 2014. v3_1. Added lambda dependence to modulation matrix. In Ideal case at least.
J. Blanco. Sep 2014. v4_0. Option trees included in 'ideal' and 'real' cases to discriminate mode depending on Mueller and LCVR's phases dependences with FOV and lambda. Changes in inputs of new modscheme_retardance
J. Blanco. Jun 2015. v4_1. Change names of modes for better description. Preparation of longit. ideal.
J. Blanco. Feb 2016. v4_2. Introducing birefringence through Mueller matrix
J. Blanco. Apr 2016. v4_3. Added theoretical averaged demodulation matrixes for the corresponding cases.
J. Blanco. Nov 2016. v4_4. Corrected bug? when retardance has FOV or lambda-dep. Not necessary probably since it should be done in setting file but all the same. Added on-screen progress display for verbose case
J. Blanco. Mar 2017. v4_5. Completed production of matrices in the general case (theoretical matrices were missing)

Filename: sophism_polmeas_modscheme_retardance

Version: 2_51 **Date:** November 2016

Description
Defines modulation scheme, consisting of modulation and demodulation functions and the demodulation matrix, from the information for LCVRs and the Mueller matrix of the system. Calculates the same including random errors, in case they are enabled. Performs also the orthogonal states for dual-beam.

Changes from previous versions:

V. Martinez Pillet
J. Blanco. 2011. v1_0. Fit into sophism
J. Blanco. Feb 2012. v2_0. Modified random errors and added dual-beam option
J. Blanco. Dec 2012. v2_1. Added varibles from input with values for LCVR errors
J. Blanco. Jan 2013. v2_2. Added theoretical (error-free) Mueller matrix. Save error values for LCVRs
J. Blanco. Jan 2014. v2_3. Removed dual-beam part, because it is done in modscheme.
J. Blanco. Sep 2014. v2_4. Take retardances, errors and angles as input from command line, better for new cases of FOV and lambda dependence.
J. Blanco. Feb 2016. v2_5. Comment the random sign generation for errors, now fixed to positive. Generate different random errors for each modulation state.
J. Blanco. Nov 2016. v2_51. Corrected the on-screen info about error signs to appear only when errors enabled

Filename: sophism_polmeas_birefringence

Version: 1_0 **Date:** July 2016

Description
Obtain the birefringence Mueller matrix from the EW variation.

Changes from previous versions:

D. Orozco v0.1
J. Blanco. Feb 2016. v1_0. Fit into sophism.
J. Blanco. Jul 2016. v1_1. Included the produced hrew model in the output save file

Filename: sophism_polmeas_birefringence_model

Version: 1_0 **Date:** February 2016

Description
Calculate the birefringence matrixes from models of spatial variation of the EW to be used in sophism_polmeas_birefringence.

Changes from previous versions:

D. Orozco v0.1
J. Blanco. Feb 2016. v1_0. Fit into sophism.

Filename: sophism_linbo

Version: 3_1 **Date:** March 2017

Description
Simulates spectral PSF of PHI with 1 LiNbO3 etalon. Program includes telecentric angle variation, dispersion, voltage tuning, temperature tuning and mean tilt angle over etalon tuning. Depending on Pupil Apodisation module, it creates 2D arrays of incident angles, etc, or makes an average of the effect if it's not enabled.

Changes from previous versions:

vmp@iac.es. December 2010.
J. Blanco. Sept 2011. v1_0. Added parameters for etalon tuning by wavelength input instead of voltage. Integration in SOPHISM code
J. Blanco. May 2012. v2_0. Pupil apodisation part and related subroutines
J. Blanco. Aug 2012. v2_1. Corrections for pupil apodisation
J. Blanco. Nov 2012. v2_2. Tuning jittering included. Neighbouring wavelengths when no sampled data exists at selected wavelengths
J. Blanco. Dec 2012. v2_3. Printing and plotting for talk mode
J. Blanco. Dec 2012. v2_4. Correction of average calc. for fffav
J. Blanco. Jan 2013. v2_5. Corrected bug for number of files (to not take into account already-discarded frames). Added possibility of loading prefilter curve from idl-save file. Still incomplete (depends on how curve is provided)
J. Blanco. May 2014. v2_6. Changed to save the llo and fwhm_real after 'interpolating' neighbouring positions, not before as previously. Brought calculation from papo for pupil apod mode. Minor changes to plots.
J. Blanco. Jul 2014. v2_7. Corrected ntim according to new cycrep scheme. Modified non-pupil apodization loop over data for discardings when polarization module has not been used.
J. Blanco. Aug 2014. v2_8. Corrected ntim in case of not polarization module for the discards. Corrected progress on-screen display for dual-beam.
H. Waller. Feb 2017. v3_0. Included prefilter variation in several modifications
J. Blanco. Mar 2017. v3_1. Corrected prefilter file reading part, now considering ASCII input file

Filename: sophism_linbo_lambint

Version: 1_0 **Date:** November 2012

Description
Determine if input wavelengths are sampled in input data or neighbouring weighting must be used

Changes from previous versions:

J. Blanco. Nov 2012. v1_0. Split from main sophism_linbo routine.

Filename: sophism_linbo_geometry

Version: 2_0 **Date:** September 2012

Description
Calculates the cone of incident angles over the etalon in telecentric mounting by means of the scalar product of the etalon's directional vector and incident rays vectors. For use in the case of pupil apodisation.

Changes from previous versions:

J. Hirzberger
J. Blanco. April 2012. v1_0. Fit into sophism
J. Blanco. September 2012. v2_0. Added pupil definition by radius_aper2 and some changes to variables.

Filename: sophism_otf

Version: 3_61 **Date:** April 2017

Description
Define OTF from diffraction or loading wavefronts, adding aberrations if selected

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2011. v1_0. Fit into sophism
J. Blanco. 2012. v2_0. Included zernikes treatment for aberrations. Loading option for zernikes collection.
J. Blanco. April 2012. v3_0. Pupil apodization part included
J. Blanco. Sept 2012. v3_1. Wavelength, pupil apodization and aliasing corrections
J. Blanco. Dec 2012. v3_2. Add printings for talk mode
J. Blanco. Jan 2013. v3_3. Corrected bug for number of files (to not take into account already-discarded frames)
J. Blanco. May 2013. v3_4. Added the wavefront to the save file
J. Blanco. Oct 2013. v3_5. Modified read_ascii for zercofile to consider comments when starting with ';'
J. Blanco. Jul 2014. v3_6. Corrected ntim according to new cycrep scheme
J. Blanco. Apr 2017. v3_61. Added ntim=1 for the case of no data series

Filename: sophism_papo

Version: 2_7 **Date:** April 2017

Description
For the case of Pupil Apodisation in SOPHISM. Convolution with OTF, and etalon transmission are performed here.

Changes from previous versions:

20-Apr-11 J. Hirzberger, MPS
J. Blanco. May 2012. v1_0. Adapted to be included in sophism. Integration range selectable.
J. Blanco. Sep 2012. v2_0. Changes of etalon transmission
J. Blanco. Nov 2012. v2_1. Neighbouring wavelengths weighting included when no sampled data at selected wavelengths
J. Blanco. Dec 2012. v2_2. Prints for talk mode
J. Blanco. Jan 2013. v2_3. Corrected bug for number of files (to not take into account already-discarded frames)
J. Blanco. Feb 2013. v2_4. Corrected format for screen print of sample numbers.
J. Blanco. Jul 2014. v2_5. Corrected ntim according to new cycrep scheme
J. Blanco. Jun 2016. v2_6. Included start at some given sample option (nstart)
J. Blanco. Apr 2017. v2_7. Adapted for no time series case

Filename: sophism_fpa

Version: 2_99 **Date:** April 2017

Description
Simulate detector readout incl. resampling, noise, ...

Changes from previous versions:

Alex Feller v0.2 2010-12-01
J. Piqueras 2011-10-01
J. Blanco.
J. Blanco. 2012. v2_0. Added gain table, conversion to photons, dual-beam mode.
J. Blanco. Dec 2012. v2_1. Display images in verbose mode.
J. Blanco. Jan 2013. v2_2. Flat generation and fringes added.
V. Martinez, J. Blanco. Feb 2013. v2_3. Corrections to photon and readout noise calculations. Inclusion of transmittance. Option to not include photon noise and dark.
J. Blanco. Jan 2014. v2_4. Changed flat generation, simplified and more variation in the FOV. Hinted options to aproximate max or min of the final flat (normalized units)
J. Blanco. May 2014. v2_5. Changed fwhm_real for its mean. Re-order the noises generation.
J. Blanco. Jun 2014. v2_6. Modified flat generation, option to give a max-min range of final flat. Added Loading/Saving photon noise option.
J. Blanco. Jul 2014. v2_7. Corrected ntim according to new cycrep scheme. Transmittance changed, in case of dual-beam, to 50% in each detector. Corrected bug in fringes generation. Loading option for gain table, modified variable name.
J. Blanco. Sep 2014. v2_8. Removed the setting of negative values to 0 in the case of no modulation. Added double keyword to the photon noise generation
J. Blanco. Nov 2014. v2_9. Introduced dead/hot pixel generation. Added cosmic rays generator
J. Blanco. May 2015. v2_95. Introduced factor for flux conversion for input data, when it is not in erg/s/cm2/...
J. Blanco. Feb 2016. v2_96. Corrected gain_table generation for ‘None' case
J. Blanco. Apr 2016. v2_97. New fringes generation, based on theory, lambda-dependent
J. Blanco. Nov 2016. v2_98. Correction of bugs when loading noises in dual-beam
J. Blanco. Apr 2017. v2_99. Added ndet=1 for the case of no data series

Filename: sophism_accu

Version: 2_4 **Date:** May 2015

Description
Performs image accumulation on detector by different ways depending on which modules (polarization/filtergraph) have been used in the simulation. The observational scheme followed is that of first modulation through LCVRs and then wavelength change (when all the modules have been run).

Changes from previous versions:

Alex Feller
J. Blanco. 2011. v1_0. Modified to fit into sophism.
J. Blanco. March 2012. v2_0. Readaptation of accumulation loops to allow different simulation options and rearrangement of summations to fit modulation schemes. Dual-beam mode
J. Blanco. Dec 2012. v2_1. Printings and displays for talk option
J. Blanco. Jul 2014. v2_2. Corrected ntim according to new cycrep scheme, and cycrep in other calculations. Added obs and according things for the different observation sets.
J. Blanco. Sep 2014. v2_3. Corrected bug in ntim for case of polarization but no etalon.
J. Blanco May 2015. v2_4. Corrected bug in the progma variable when loading input data directly

Filename: sophism_demod

Version: 2_31 **Date:** April 2017

Description
Demodulates the accumulated images of the simulation run with the demodulation matrix calculated at the polarization module. Adds the two beams of dual-beam mode.

Changes from previous versions:

J. Blanco. 2011.
J. Blanco. Feb 2012. v1_1. Demodulation for random errors in matrix
J. Blanco. Nov 2012. v1_2. Added the adhoc correction option
J. Blanco. Dec 2012. v1_3. Show demodulated images for talk mode
J. Blanco. Dec 2012. v1_4. Rearrange 'show' before ad-hoc correction
J. Blanco. Jan 2013. v1_5. Add demodulation with theoretical matrix also in case of errors in Mueller matrix
J. Blanco. Jan 2014. v1_6. Demodulation matrixes stored in ..._scheme_demod.sav starting in sophism_polmeas_modscheme 3.0. Adapted to 2D demodulation matrixes and averaged.
J. Blanco. Jun 2014. v1_7. Demodulation matrixes with lambda dependence (with or without FOV-dep.). All 4 cases (simple modulation, lambda-modulation, FOV-modulation, FOVandlambda-modulation) considered
J. Blanco. Jul 2014. v1_8. Adapted for observation sets.
J. Blanco. Aug 2014. v1_9. Readapted modulation cycles' demodulation.
J. Blanco. Sep 2014. v2_0. Correction for 'real' cases with FOV/lambda dependencies and the demodulation matrixes they generate
J. Blanco. Nov 2014. v2_1. Corrected bug when reading data for adhoc. Changed output names for adhoc data.
J. Blanco. Jul 2015. v2_2. Corrected wrong variable name for dual-beam wrong-demodulation
J. Blanco. Feb 2016. v2_3. Corrected bug continuum position for ad-hoc subroutine
J. Blanco. Apr 2017. v2_31. Allow for starting with data other than accumulated (mostly thinking in no data series)

Filename: sophism_demod_adhoc

Version: 1_2 **Date:** February 2016

Description
Corrects crosstalk from Stokes V to Q and U by a linear fitting.

Changes from previous versions:

J. Blanco. Nov 2012. v1_0. Derived after IMaX reduction programs
J. Blanco. Jan 2015. v1_1. Included the invercont variable for the continuum position selected by user.
J. Blanco. Feb 2016. v1_2. Corrected bug with continuum position

Filename: sophism_inversion

Version: 1_1 **Date:** April 2017

Description
Simulate the inversion data of SOPHI using C version of MILOS

Changes from previous versions:

J. Blanco. Mar 2017. v1_0. Inversion using C version of MILOS.
J. Blanco. Apr 2017. v1_1. Include option to perform inversion only on a given area of the FOV (to speed things up).

Filename: sophism_compression

Version: 1_4 **Date:** June 2016

Description
Simulate the data compression. Right now (June 2016), the compression code is only available in windows executable. Thus, it has to be run through wine command. In principle, any wine linux distribution should work.

Changes from previous versions:

A. Lagg May 2014. Original routines
J. Blanco May 2014. v1_0. Fit into sophism
J. Blanco Jul 2014. v1_1. Adapted for observation sets. Included cases for theoretical (random errors in modulation), average (FOV and/or lambda dependent modulation), and dual (if it's not demodulated data which are going to be used)
J. Blanco Nov 2014. v1_2. Corrected the output decompressed files size, depending whether it has been replicated or not
J. Blanco May 2015. v1_3. Corrected bug in the progma variable when loading input data directly
J. Blanco Jun 2016. v1_4. Modified replication for cases where input data size < 128 pix. Now replicates the necessary factor. Re-arranged histogram display. Remove intermediate files

Filename: sophism_report

Version: 3_1 **Date:** February 2016

Description
Generates a simulation report, including parameters, graphs, images,...

Changes from previous versions:

Alex Feller v0.1 2010-09-21
J. Blanco. 2012. v1_0. Adapted for sophism. Changed to printf mode adapting from Hirzberger
J. Blanco. Nov 2012. v2_0. Major changes in most parts. Images from inversion part included now
J. Blanco. Dec 2012. v2_1. Modified to use the 'report modules' settings
J. Blanco. Sep 2014. v3_0. Updating whole routine to reflect latest changes in simulator
J. Blanco. Feb 2016. v3_1. Corrected for case of various observation sets in spectral positions list and demodulation