Specification of the R3XA format

This specification is automaticaly generated by the current schema.json

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Contents

1 R3XA Specification

Version : `2024.7.1`

Yet another metadata file format whose goal is to provide a data representation scheme compatible with the variety of data types encountered in experimental and computational photomechanics, and to provide a convenient framework for software coupling and data fusion.

1.1 General structure

Section	Description
`header`	Top-level metadata fields (`title`, `description`, `version`, authorship and links).
`settings`	Experimental setup and specimen metadata.
`data_sources`	Sensors and processing blocks that produce data.
`data_sets`	Data containers linked to one or more data sources.

1.2 Header

Field	Type	Required	Description
`title`	string	Yes	Title of the data sets.
`description`	string	Yes	Description of the data sets.
`version`	“2024.7.1” (fixed)	Yes	Version of the schema used.
`authors`	string	Yes	Names, ORCID, IDHAL…
`date`	string	Yes	Global date of the experiment (YYYY-MM-DD).
`repository`	string		URL to the repository where the dataset is stored.
`documentation`	string		URI to the documentation (pdf)
`license`	string		Public domain, CC-BY, …

1.3 Settings

Experimental parameters should be the specimen, patterning technique and machines used (light, testing rig, environmental chamber…). Describe the experimental techniques/apparatus and devices used / light / environment chamber…

Allowed item kinds: Generic | Specimen | Testing Machine | Stereorig

1.3.1 Generic experimental setup (`settings/generic`)

Generic setup: testing device, environmental chamber, lights…

Field	Type	Required	Description
`id`	string	Yes	ID of the setting.
`kind`	“settings/generic” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the setting.
`description`	string	Yes	Description of the setting.
`Documentation`	string		Path to external documentation/information
`associated_data_sources`	array	Data source id	List of datasources linked to this setting

1.3.2 Specimen (`settings/specimen`)

Specimen.

Field	Type	Required	Description
`id`	string	Yes	ID of the setting.
`kind`	“settings/specimen” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the specimen.
`description`	string	Yes	Description of the specimen.
`cad`	string		Path to the design of the specimen.
`sizes`	array[Unit]	Yes	Sizes of the specimen.
`patterning_technique`	string		Patterning technique used on the specimen.
`patterning_feature_size`	Unit		Characteristic size of the pattern.

1.3.3 Stereo rig (`settings/stereorig`)

Multicamera stereo rig.

Field	Type	Required	Description
`id`	string	Yes	ID of the setting.
`kind`	“settings/stereorig” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the stereo rig.
`description`	string	Yes	Description of the stereo rig.
`stereo_angle`	Unit	Yes	Stereo angle between the camera axes.

Field	Type	Required	Description
`calibration_target_type`	string		Type of calibration board.
`calibration_target_size`	array[Unit]		Parameters of the calibration board.
`associated_data_sources`	array[Data source id]		List of cameras of the rig

1.3.4 Testing machine (`settings/testing_machine`)

any type of testing machine.

Field	Type	Required	Description
`id`	string	Yes	ID of the setting.
`kind`	"settings/testing_machine" (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the testing machine.
`description`	string	Yes	Description of the testing machine.
`type`	string	Yes	e.g. compression, tensile, torsion, fatigue…
`manufacturer`	string		Manufacturer, vendor or software editor.
`model`	string		Model of the source or software version.
`documentation`	string		filename
`capacity`	unsigned integer		load capacity
`associated_data_sources`	array[Data source id]		List of associated sources (extensometers, load cells)

1.4 Data Sources

A data source is a procedure or a system that generates a data set. If it is a sensor then its parameters must be specified. If it is an analysis, its parameters are specified along with the input parameters. It also indicates the dimension, the number of components and the unit of the output data.

Allowed item kinds: Generic | Camera | Infrared | Tomograph | Load Cell | Strain Gauge | Point Temperature | Dic Measurement | Mechanical Analysis | Identification | Strain Computation

1.4.1 Generic data source (`data_sources/generic`)

A data source is a procedure or a system that generates a data set. If it is a sensor then his parameters must be specified. If it is an analysis specifies his parameters are specified along with the input parameters. It also indicates the dimension, the number of components and the unit of the output data.

Field	Type	Required	Description
`id`	string	Yes	ID of the data source
`kind`	“data_sources/generic” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the data source.
`description`	string	Yes	Description of the data source.
`input_data_sets`	arrayData set id		Data sets IDs serving as inputs of the source.
`output_components`	unsigned integer	Yes	Number of components or channels of the ouput data.
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	must be one of: point, curve, surface or volume.
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string	Yes	Manufacturer, vendor or software editor.
`model`	string	Yes	Model of the source or software version.
`documentation`	string		Documentation filename, path or URL

1.4.2 Visible Camera (`data_sources/camera`)

Generic camera in visible range.

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/camera” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the camera.
`description`	string		Description of the camera.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components or channels of the ouput data.
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’

Field	Type	Required	Description
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer name, Brand.
`model`	string		Camera model.
`documentation`	string		Documentation filename, path or URL
`image_size`	array[Unit]	Yes	Size of the image length unit squared.
`field_of_view`	array[Unit]		Size of the field of view in length unit squared.
`image_scale`	Unit		Scale of the image in pixels per length unit.
`focal_length`	Unit		Focal length of the lens in length unit.
`lens`	string		Lens manufacturer and model names.
`filter`	string		Filter type, manufacturer and model.
`aperture`	string		Aperture of the lens, example: f/8
`exposure`	Unit		Exposure time in time unit.
`standoff_distance`	Unit		Distance between the camera and the sample.
`uncertainty`	Unit		Estimation of image noise.

1.4.3 Infrared Camera (`data_sources/infrared`)

Generic infrared camera

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/infrared” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the infrared camera.
`description`	string		comments and additional informations
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.

Field	Type	Required	Description
`output_components`	unsigned integer	Yes	Number of channels of the ouput data
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’.
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer, Brand
`model`	string		Model
`documentation`	string		Documentation filename, path or URL
`image_size`	array[Unit]	Yes	Size of the image length unit squared.
`field_of_view`	array[Unit]		Size of the field of view in length unit squared.
`image_scale`	Unit		Scale of the image in pixels per length unit.
`focal_length`	Unit		Focal length of the lens in lenght unit.
`lens`	string		Camera lens manufacturer and model names.
`filter`	string		Filter type, manufacturer and model.
`aperture`	string		Aperture of the lens.
`exposure`	Unit		Exposure time in time unit.
`standoff_distance`	Unit		Standoff distance between the camera and the sample in length unit.
`bandwidth`	array[Unit]	Yes	Bandwidth [item0, item1]
`emissivity`	Unit		Emissivity
`transmissivity`	Unit		Transmissivity
`nuc_file`	string		Non Uniformity Correction
`calibration_file`	string		filename
`uncertainty`	Unit		estimation of image noise.

1.4.4 Tomograph X-Ray (`data_sources/tomograph`)

Generic tomograph

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.

Field	Type	Required	Description
`kind`	“data_sources/tomograph” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Title of the tomograph.
`description`	string		Description of the tomograph.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of channels of the ouput data.
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’ for radios or ‘volume’ for scans.
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer, vendor or software editor.
`model`	string		Model or software version.
`documentation`	string		Documentation filename, path or URL
`image_size`	array[Unit]	Yes	Size of the image pixels.
`field_of_view`	array[Unit]		Size of the field of view in length unit.
`image_scale`	Unit		Scale of the image in pixels per length unit.
`source`	string	Yes	Source characteristics.
`voltage`	Unit		Used voltage.
`current`	Unit		electric current.
`detector`	string		electric current.
`scan_duration`	Unit		Scan duration
`target`	string		reflexion target.
`tube_to_detector_distance`	Unit		Distance between the tube and the detector.
`source_to_object_distance`	Unit		Distance between the source and the object.
`number_of_projections`	unsigned integer		number of radiographs.
`angular_amplitude`	Unit		amplitude in degree, example: 360
`aquisition_param_file`	string		filename
`reconstruction_param_file`	string		filename

`uncertainty`	Unit		estimation of image noise or artifacts.

1.4.5 Load Cell (`data_sources/load_cell`)

Load cell, Force cell

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/load_cell” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Load cell name
`description`	string		Description of the load cell
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components of the ouput data, example 1 for single axis or 6 for 6-axis sensors
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘point’
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer, vendor, brand.
`model`	string		Model.
`documentation`	string		Documentation filename, path or URL
`type`	string		(e.g. wheatstone, piezzo-electric, FSR).
`capacity`	Unit	Yes	Capacity of the load cell / Force range.
`uncertainty`	Unit		Quantification of data uncertainty.

1.4.6 Strain Gauge (`data_sources/strain_gauge`)

Strain gauge, Rosette, Extensometer…

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/strain_gauge” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Strain gauge name

Field	Type	Required	Description
`description`	string		Description of the load cell
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components of the ouput data, example: 1 or 3 for rosette.
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘point’
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer, Vendor or brand.
`model`	string		Model.
`documentation`	string		Documentation filename, path or URL
`length`	Unit	Yes	Gauge or measuring length
`uncertainty`	Unit		Uncertainty or resolution of strain.

1.4.7 Point Temperature (`data_sources/point_temperature`)

thermocouples, Resistance Temperature Detectors (RTDs), thermistor, pyrometer…

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/point_temperature” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Thermometer name
`description`	string		Description of thermometer
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components of the ouput data, should be 1
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘point’
`output_units`	array[Unit]	Yes	Unit of the output data.
`manufacturer`	string		Manufacturer, vendor or software editor.

Field	Type	Required	Description
`model`	string		Model or software version.
`documentation`	string		Documentation filename, path or URL
`range`	array[Unit]	Yes	Temperature range [item0, item1]
`emissivity`	Unit		Pyrometer emissivity
`uncertainty`	Unit		uncertainty or resolution.

1.4.8 Digital Image Correlation measurement (`data_sources/dic_measurement`)

DIC, DVC, Stereo DIC

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/dic_measurement” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Name of the DIC measurement.
`description`	string		Description of the DIC measurement.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’ for DIC or ‘volume’ for DVC
`output_units`	array[Unit]	Yes	examples: pixels, voxels, length unit…
`manufacturer`	string		Software editor.
`model`	string		Software version.
`documentation`	string		Documentation filename, path or URL
`subset_size`	array[Unit]		Size of the subset length unit squared.
`step_size`	Unit		distance between two adjacent subsets
`mesh`	string		Finite Element or BSpline mesh: filename or specimen setting id
`image_filtering`	string		Type of filter and kernel

Field	Type	Required	Description
`interpolant`	string		Subpixel interpolation: linear, cubic spline
`matching_criterion`	string	Yes	ZNSSD, ZNCC or other …
`shape_function`	string		affine, quadratic, linear triangles TRI3 …
`camera_model`	string		no, pinhole, distortions modes…
`camera_parameters`	string		filename or list of parameters
`regularization_type`	string		strong/weak + type: gradient, elastic…
`regularisation_length`	Unit		length or weight
`uncertainty`	Unit		e.g. uncertainty on the output field

1.4.9 Mechanical analysis (`data_sources/mechanical_analysis`)

numerical simulation of a mechanical model

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/mechanical_analysis” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Name of the data analysis.
`description`	string		Description of the mechanical model.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’ for 2D or ‘volume’ for 3D
`output_units`	array[Unit]	Yes	examples: %, microdefs…
`manufacturer`	string	Yes	Software name.
`model`	string		Software version.
`documentation`	string		Documentation filename, path or URL
`parameters`	array[Unit]		constitutive, geometric, loading or numerical parameters

Field	Type	Required	Description
`uncertainty`	Unit		estimation of numerical errors

1.4.10 Parameter identification (`data_sources/identification`)

inverse problem or model updating

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/identification” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string		Name of the inverse analysis.
`description`	string		Description of the identification method and parameters used.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’ for 2D or ‘volume’ for 3D
`output_units`	array[Unit]	Yes	examples: %, microdefs…
`manufacturer`	string		Software name.
`model`	string		Software version.
`documentation`	string		Documentation filename, path or URL
`parameters`	array[Unit]		constitutive, geometric, loading or numerical parameters
`uncertainty`	Unit		estimation of identification uncertainty

1.4.11 Computing strains from displacement field (`data_sources/strain_computation`)

Post-processing measured of simulated displacement fields to compute strains

Field	Type	Required	Description
`id`	string	Yes	ID of the data source.
`kind`	“data_sources/strain_computation” (fixed)	Yes	Only required for specs implementation purposes.

Field	Type	Required	Description
`title`	string		Name of the data analysis.
`description`	string		Additional description of the way strains are computed from displacements.
`input_data_sets`	arrayData set id		Data sets IDs serving as an input to the source.
`output_components`	unsigned integer	Yes	Number of components
`output_dimension`	“point” | “curve” | “surface” | “volume”	Yes	should be ‘surface’ for 2D or ‘volume’ for 3D
`output_units`	array[Unit]	Yes	examples: %, microdefs…
`manufacturer`	string		Software name.
`model`	string		Software version.
`documentation`	string		Documentation filename, path or URL
`virtual_strain_gauge_size`	Unit	Yes	
`displacement_filtering`	string		Type of filter and kernel
`strain_filtering`	string		Type of filter and kernel
`uncertainty`	Unit		estimation of uncertainty on the output

1.5 Data Sets

A data set gives the organisation of the measured or generated data and time resolution.

Allowed item kinds: Generic | File | List

1.5.1 Generic data set (`data_sets/generic`)

Description of the data set.

Field	Type	Required	Description
`id`	string	Yes	ID of the data set.
`kind`	“data_sets/generic” (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the data set.
`description`	string	Yes	Description of the data set.
`file_type`	string	Yes	MIME type of the file.

Field	Type	Required	Description
`path`	string	Yes	Relative path to the data file.
`data_sources`	arrayData source id	Yes	List of IDs of the data sources.

1.5.2 Data set (single file) (`data_sets/file`)

When all the timestamps and data is stored in a single tablular like file (like csv or txt). If the timestamps and data are in two separate files they should be in the same folder.

Field	Type	Required	Description
`id`	string	Yes	ID of the data set.
`kind`	"data_sets/file" (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the data set.
`description`	string	Yes	Description of the data set.
`folder`	string		Relative path to the folder containing the timestamps and data file(s).
`data_sources`	arrayData source id	Yes	List of IDs of the data sources.
`time_reference`	number	Yes	Time serving as a reference to the whole data set.
`keywords`	array[string]		List of keywords.
`timestamps`	Data set file	Yes	Path and range to the timestamps file
`data`	Data set file	Yes	Path and range to the data file

1.5.3 Data set (list of files) (`data_sets/list`)

When all the data is stored in separated files (like a list of images). They should all be in the same folder.

Field	Type	Required	Description
`id`	string	Yes	ID of the data set.
`kind`	"data_sets/list" (fixed)	Yes	Only required for specs implementation purposes.
`title`	string	Yes	Title of the data set.
`description`	string	Yes	Description of the data set.
`path`	string		Relative path to the data folder.

Field	Type	Required	Description
`file_type`	string	Yes	MIME type of the data files.
`data_sources`	arrayData source id	Yes	List if IDs of the data sources.
`time_reference`	Unit	Yes	Time serving as a reference to the whole data set.
`keywords`	array[string]		List of keywords.
`timestamps`	array[number]	Yes	List of the timestamps.
`data`	array[string]	Yes	List of the data files.

1.6 Annexe — Types communs

1.6.1 Setting id

ID of a setting.

Property	Value
`type`	string

1.6.2 Data set id

ID of a data set.

Property	Value
`type`	string

1.6.3 Data source id

ID of a data source.

Property	Value
`type`	string

1.6.4 Data set file

Field	Type	Required	Description
`filename`	string	Yes	
`file_type`	string		MIME type of the file.
`delimiter`	string		
`data_range`	string		
`kind`	“data_set_file” (fixed)	Yes	Only required for specs implementation purposes

1.6.5 Unit

Field	Type	Required	Description
`title`	string		Title of the unit.
`value`	number		Numerical value.
`unit`	string	Yes	Sign of the unit.
`scale`	number		Factor with respect to the standard system
`kind`	“unit” (fixed)	Yes	Only required for specs implementation purposes

1.6.6 unsigned integer

Unsigned int

Property	Value
`type`	integer