



Supplement to: SOP “iFDO creation”

This supplemental material provides detailed information on all characteristics of iFDOs. All material herein is released under CC-0.

Content:

- A description of iFDO icons for fixed iFDO field terms

References:

- SOP “iFDO creation“: <https://doi.org/10.5281/zenodo.5681429>
- FAIR marine images: <https://marine-imaging.com/fair>

Information about this document:

Title: Image curation and publication

Authors: Timm Schoening

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Abstract: This supplemental material extends the information in the SOP “iFDO creation”. That SOP describes how standardized metadata for images can be created.

Note: This material is kept generic. More iFDO fields are expected in the future.

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v1.0.0	2021/11	Timm Schoening	Initial draft of a public text version of this supplement. Compiled from discussions in the MareHub AG Videos/Images.

Introduction

Achieving FAIRness and openness of (marine) image data requires structured and standardized metadata on the image data itself and the visual and semantic image data content. This metadata shall be provided in the form of FAIR digital objects (FDOs). This document provides supplementary material describing information contained in iFDOs. An iFDO is a human and machine-readable file format for an entire image set, except that it does not contain the actual image data, only references to it through persistent identifiers! See the website <https://www.marine-imaging.com/fair> and the main document “SOP iFDO Creation” for reference (<https://doi.org/10.5281/zenodo.5681429>).

iFDOs consist of various metadata fields. Some are required, some are recommended, some are optional. You will only achieve FAIRness of your image data with the required iFDO *core* fields populated. You will only gain visibility and credit for your image data with the recommended iFDO *capture* fields populated. And you will only have awesome image data in case you also populate the iFDO *content* fields. As a bonus you can add your own domain-specific optional fields.

An iFDO file can consist of a header and items part. The header part contains the default of all metadata information. The image item information part contains all the information where the individual images require their specific metadata value. An example is the coordinate: for a moving camera, all image items require their own image-latitude value. In case of a stationary camera, the image-latitude value in the image-set-header part can be used instead.

File format

All image metadata shall be stored in one image FAIR digital object (iFDO) file. This file shall contain all iFDO fields, most importantly the header and detail fields for the image set (aka the core iFDO fields). The file should be human and machine-readable, hence *.yaml format is recommended. The file name should be:

```
<image-project>_<image-event>_<image-sensor>_iFDO.yaml
```

iFDO sections

iFDO core: Marine image data collections need a core set of standardized metadata for FAIR and open publication. An entire image set (e.g. deployment) requires header information on the ownership and allowed usage of the collection. Numerical metadata is required for each image on its acquisition position.

iFDO capture: Information on how image data was captured can be crucial to understand information extracted from the images. It is thus highly recommended to enrich all iFDOs with capture information. Some capture metadata are specified here for the purpose of promoting imagery in the marine data portal and in other contexts. The potential metadata in the iFDO capture fields is expected to grow with time, as additional (marine) imaging domains make use of this concept. Below you find a pool of iFDO capture fields which are highly recommended to be added to your iFDO. Only with these fields populated will your dataset shine.

iFDO content: Image data is inherently unstructured and obtaining a glimpse of its content is hard to achieve for humans as well as machines. The iFDOs content fields are a mechanism to encode the content of image data by means of visual, textual or other data proxies (annotations, previews, descriptions, categorizations, etc.). These can take various forms as described below. Simple examples of visual proxies are thumbnails for images or the average intensity along a video.

iFDO icons

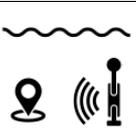
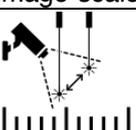
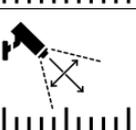
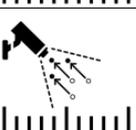
Some of the iFDO fields require using well-defined values for those fields as described in the tables on the specific iFDO sections. For these well-defined values, icons were created to enable visualizing this capture information in web interfaces or data processing reports. These icons are available in the resources folder and an overview is given here. You are free to use these icons. They are released publicly under CC-0.

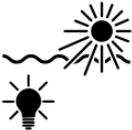
iFDO core icons

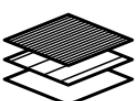
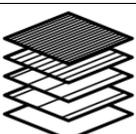
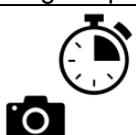
Icon	Value	Description
image-license		
	CC-0	You can copy, modify, distribute and perform the work, even for commercial purposes, all without asking permission
	CC-BY	You are free to share and adapt the images as long as you give appropriate credit, link to the license, indicate your changes.

iFDO capture icons

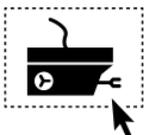
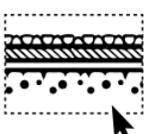
Icon	Value	Description
image-acquisition		
	photo	The image set contains still images
	video	The image set contains moving images
	slide	The image set contains microscopy / slide scans
image-quality		
	raw	The images in the image set come straight from the sensor
	processed	The images in the image set have been QA/QC'd
	product	The images in the image set are ready for interpretation
image-deployment		
	exploration	The camera followed an unplanned path execution
	survey	The camera followed a planned path execution along a free path
	mapping	The camera followed a planned path execution along 2-3 spatial axes

	stationary	The camera remained in a fixed spatial position
	experiment	The camera observed a manipulation of the environment
	sampling	The camera imaging samples taken by other method ex-situ
image-navigation		
	beacon	Position data was created from underwater beacons (USBL, ...) for an underwater position
	transponder	Position data was created from underwater beacons (USBL, LBL, ...) for an underwater position
	satellite	Position data was created from satellite information (GPS, Galileo, ...) for the sea surface
	reconstructed	Position data was estimated from other measures like cable length and course over ground
image-scale-reference		
	laser marker	Meter-scale in the images was determined by laser markers visible in the images
	calibrated camera	Meter-scale in the images was determined by image data and additional external data like object distance
	3D camera	Meter-scale in the images was determined by 3D imaging / reconstruction
	optical flow	Meter-scale in the images was determined from the relative movement of the images and the camera navigation data
image-illumination		
	sun	The scene is only illuminated by the sun

	artificial	The scene is only illuminated by artificial light
	mixed	The scene is illuminated by both sunlight and artificial light
image-resolution		
	µm	The average size of a pixel in the image set is on the order of 1 µm
	mm	The average size of a pixel in the image set is on the order of 1 mm
	cm	The average size of a pixel in the image set is on the order of 1 cm
	dm	The average size of a pixel in the image set is on the order of 1 dm = 0.1 m
	m	The average size of a pixel in the image set is on the order of 1 m
	dam	The average size of a pixel in the image set is on the order of 1 dam = 10 m
	hm	The average size of a pixel in the image set is on the order of 1 hm = 100 m
	km	The average size of a pixel in the image set is on the order of 1 km
image-marine-zone		
	seafloor	The images were taken in/on/right above the seafloor
	watercolumn	The images were taken in the water column without the seafloor or the sea surface in sight
	seasurface	The images were taken right below the sea surface

	atmosphere	The images were taken outside of the water
	laboratory	The images were taken ex-situ
image-spectral-resolution		
	grayscale	The images consist of one color channel
	rgb	The images consist of three color channels
	multi-spectral	The images consist of 4-10 color channels
	hyper-spectral	The images consist of more than 10 channels
image-capture-mode		
	timer	The image acquisition was triggered by a timer
	timer-and-manual	The image acquisition was triggered by both a timer and manual interaction
	manual	The acquisition was triggered by manual interaction

iFDO content icons

Icon	Value	Description
image-annotation-label-types		
	operation	The annotations document gear operations
	geology	The annotations document geological entities

	biology	The annotations document biological entities
	garbage	The annotations document garbage
image-annotation-geometry-types		
	whole-image	The annotations are assigned to entire images without selecting any pixel regions
	single-pixel	The annotations are assigned to single pixel locations
	polygon	The annotations are assigned to detailed outlines of objects of interest
	bounding-box	The annotations are assigned to bounding boxes around objects of interest
image-annotation-creator-types		
	non-expert	The annotations were created by trained non-experts
	expert	The annotations were created by trained experts
	crowd-sourced	The annotations were created by untrained annotators
	ai	The annotations were created automatically by an algorithm