IEA Wind Task 52 – Wind Lidar Ontology Group

Task 52 General Meeting 2023

WG7 presentation

Francisco Costa, Dexing Liu

@University of Stuttgart - SWE

Online

13 June 2023

WG7 – Wind Lidar Ontology Group

The team

Aidan Keane –@Wood Group

Andy Clifton – @EnviConnect

Ashim Giyanani – @Fraunhofer

Carlo Alberto Ratti –@Enlight

Francisco Costa, Dexing Liu

– SWE@University of Stuttgart

WG7 – Wind Lidar Ontology Group

Objectives

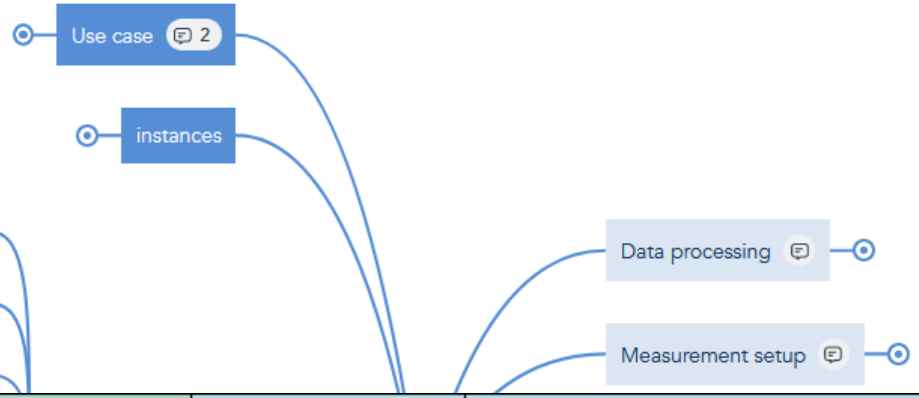
1. Develop a formal, clear and dedicated controlled vocabulary for lidar terms
2. Convert lidar knowledge into FAIR (Findable, Accessible, Interoperable and Reusable) lidar knowledge
3. Long term updates and maintenance of the ontology

iea wind

WG7 – Wind Lidar Ontology Group

The plan

- Create a working group
- The Mind map → Taxonomy
- Define lidar concepts

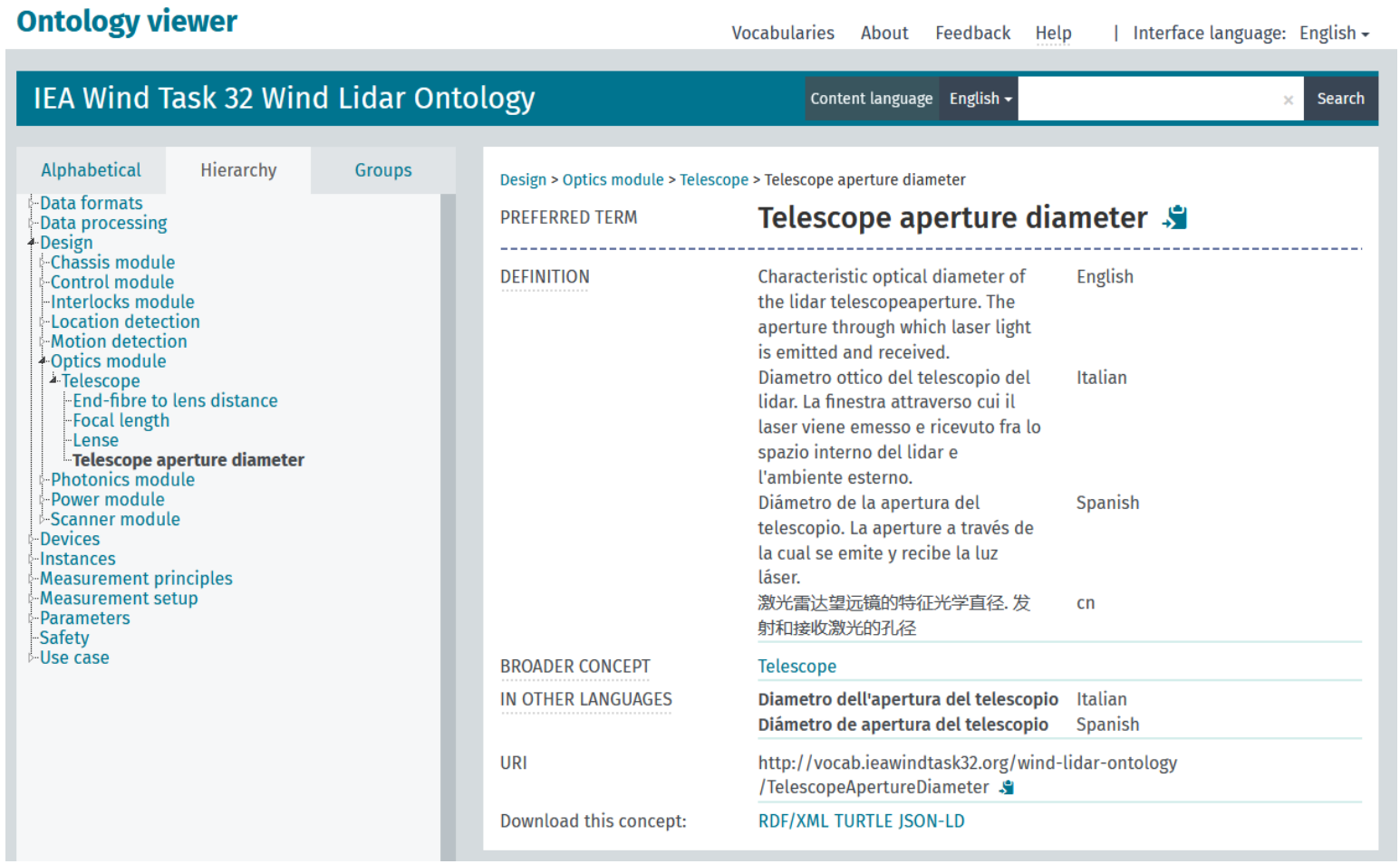


Definitions

70	ontolidar:OpticsModule	The optics module is designed to alter the original laser beam into radiation with desired specification that can be sent to the target and received by the detector properly.		Parte del lidar che trasforma le proprietà della luce laser da quelle della sorgente a quelle ottimali per essere inviate sul target e poi raccolte dal ricevitore.
71	ontolidar:Telescope	The system of lenses, mirrors and other optical and mechanical components that emit and receive laser light.		Il sistema di lenti, specchi ed altri elementi ottici e meccanici che in un lidar emettono e ricevono luce laser.
72	ontolidar:TelescopeApertureDiameter	Characteristic optical diameter of the lidar telescope. The aperture through which laser light is emitted and received.		Diametro ottico del telescopio del lidar. La finestra attraverso cui il laser viene emesso e ricevuto fra lo spazio interno del lidar e l'ambiente esterno.
73	ontolidar:FocalLength	Distance between the lense and the target.		Distanza fra il centro della lente ed il suo punto focale.
74	13.06.2023 ontolidar:EndFibreToLensDistance	Distance between the end-fibre and the lens. Continuous wave lidars use this distance to vary the focal length.		Distanza fra il punto terminale della fibra ottica ed il centro della lente.

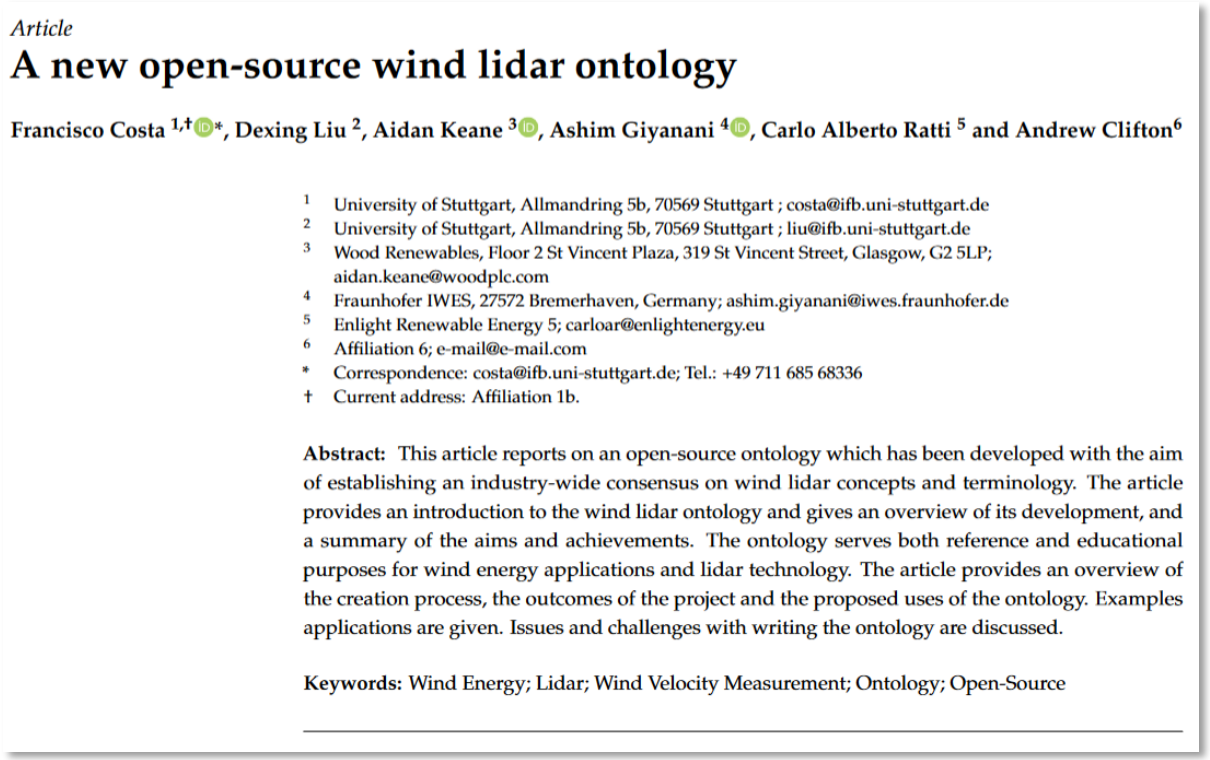
WG7 – Wind Lidar Ontology Group

The Lidar Ontology



iea wind

WG7 – Wind Lidar Ontology Group Deliverables



Article

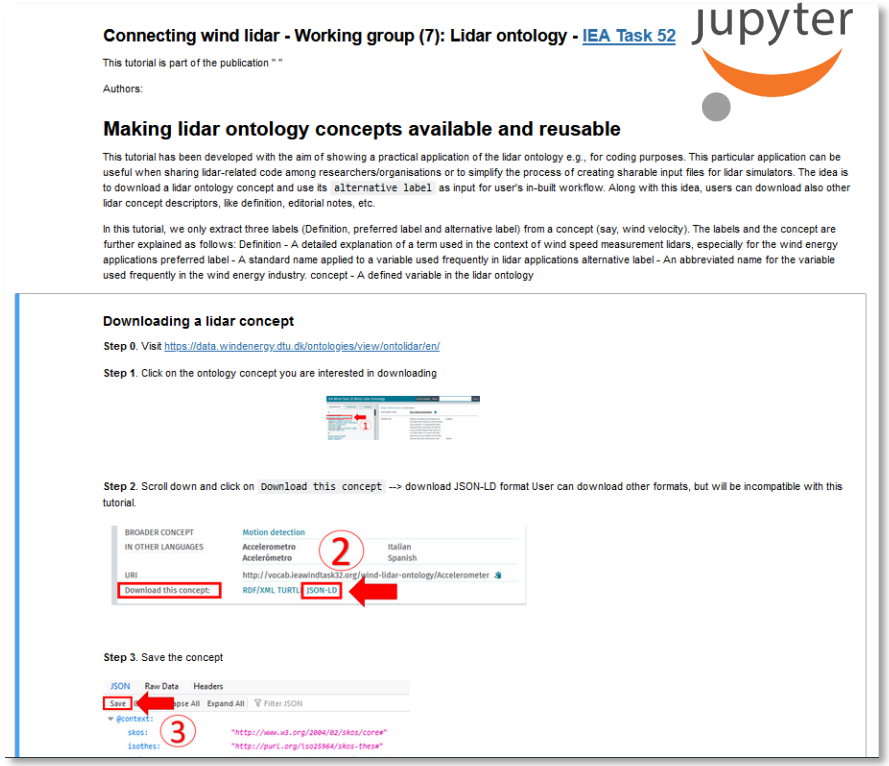
A new open-source wind lidar ontology

Francisco Costa [1,†]*, Dexing Liu [2], Aidan Keane [3], Ashim Giyanani [4], Carlo Alberto Ratti [5] and Andrew Clifton[6]

1 University of Stuttgart, Allmandring 5b, 70569 Stuttgart ; costa@ifb.uni-stuttgart.de
2 University of Stuttgart, Allmandring 5b, 70569 Stuttgart ; liu@ifb.uni-stuttgart.de
3 Wood Renewables, Floor 2 St Vincent Plaza, 319 St Vincent Street, Glasgow, G2 5LP; aidan.keane@woodplc.com
4 Fraunhofer IWES, 27572 Bremerhaven, Germany; ashim.giyanani@iwes.fraunhofer.de
5 Enlight Renewable Energy 5; carloar@enlightenergy.eu
6 Affiliation 6; e-mail@e-mail.com
* Correspondence: costa@ifb.uni-stuttgart.de; Tel.: +49 711 685 68336
† Current address: Affiliation 1b.

Abstract: This article reports on an open-source ontology which has been developed with the aim of establishing an industry-wide consensus on wind lidar concepts and terminology. The article provides an introduction to the wind lidar ontology and gives an overview of its development, and a summary of the aims and achievements. The ontology serves both reference and educational purposes for wind energy applications and lidar technology. The article provides an overview of the creation process, the outcomes of the project and the proposed uses of the ontology. Examples applications are given. Issues and challenges with writing the ontology are discussed.

Keywords: Wind Energy; Lidar; Wind Velocity Measurement; Ontology; Open-Source



Connecting wind lidar - Working group (7): Lidar ontology - IEA Task 52

This tutorial is part of the publication " "

Authors:

Making lidar ontology concepts available and reusable

This tutorial has been developed with the aim of showing a practical application of the lidar ontology e.g., for coding purposes. This particular application can be useful when sharing lidar-related code among researchers/organisations or to simplify the process of creating sharable input files for lidar simulators. The idea is to download a lidar ontology concept and use its `alternative label` as input for user's in-built workflow. Along with this idea, users can download also other lidar concept descriptors, like definition, editorial notes, etc.

In this tutorial, we only extract three labels (Definition, preferred label and alternative label) from a concept (say, wind velocity). The labels and the concept are further explained as follows: Definition - A detailed explanation of a term used in the context of wind speed measurement lidars, especially for the wind energy applications preferred label - A standard name applied to a variable used frequently in lidar applications alternative label - An abbreviated name for the variable used frequently in the wind energy industry. concept - A defined variable in the lidar ontology

Downloading a lidar concept

Step 0. Visit https://data.windenergy.dtu.dk/ontologies/view/ontolidar/en/

Step 1. Click on the ontology concept you are interested in downloading

Step 2. Scroll down and click on `Download this concept` --> download JSON-LD format User can download other formats, but will be incompatible with this tutorial.

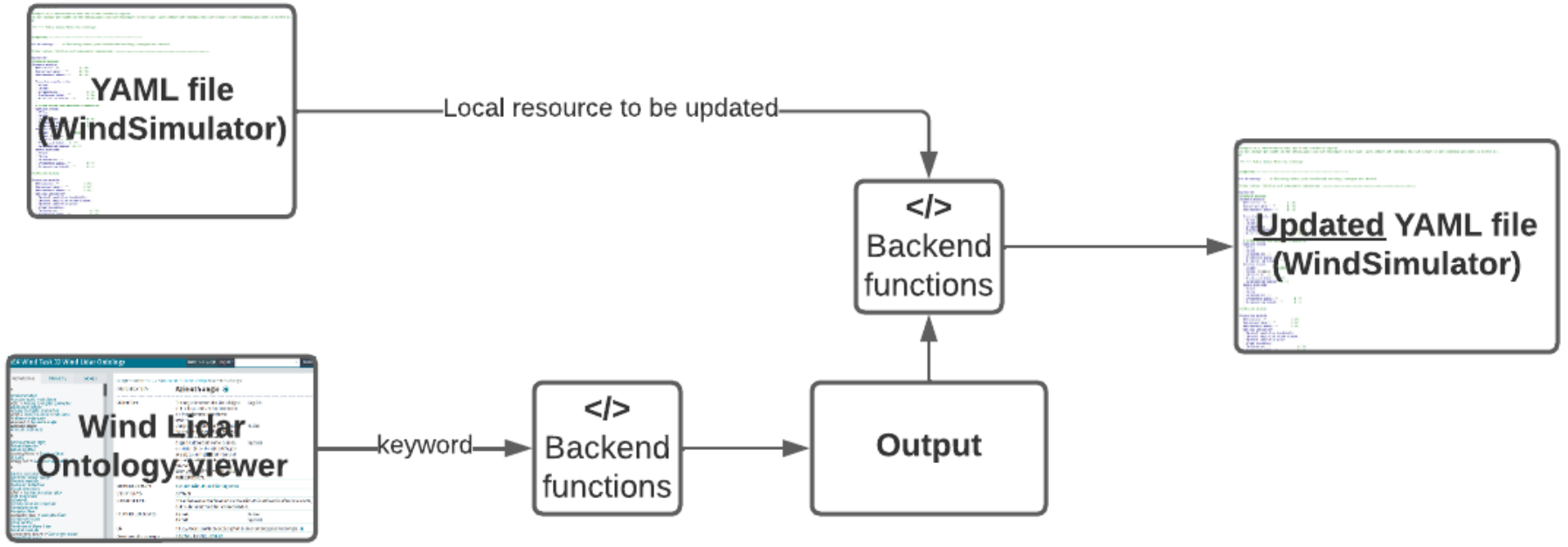
BROADER CONCEPT
IN OTHER LANGUAGES
Motion detection
Accelerometro
Acelerómetro
Italian
Spanish
URI
http://vocab.ieawindtask32.org/wind-lidar-ontology/Accelerometer
Download this concept:
RDF/XML TURTL JSON-LD
2

Step 3. Save the concept

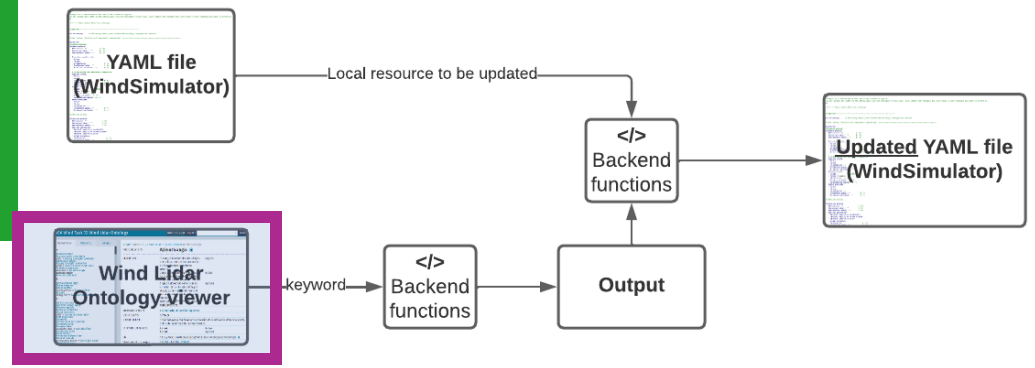
JSON Raw Data Headers
Save
Expand All
Filter JSON
@context:
skos: "http://www.w3.org/2004/02/skos/core#"
isothes: "http://purl.org/iso25964/skos-thes#"
3

Jupyter notebook

The application: Wind simulator

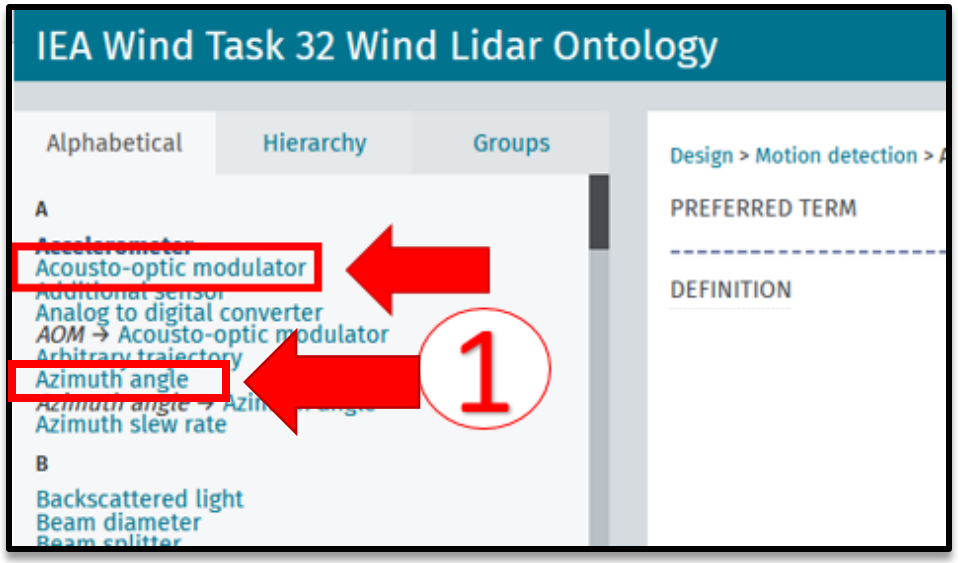


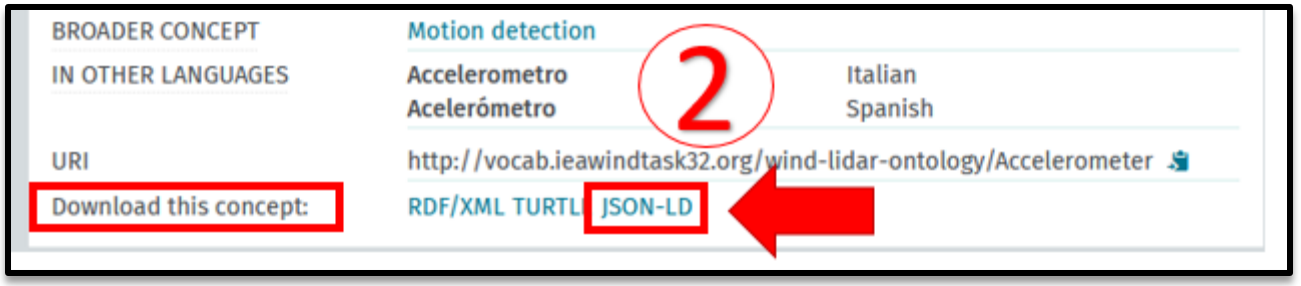
Jupyter notebook

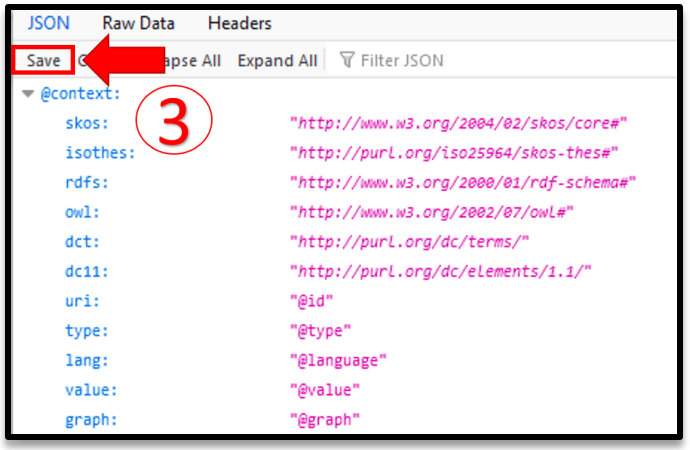


The inputs

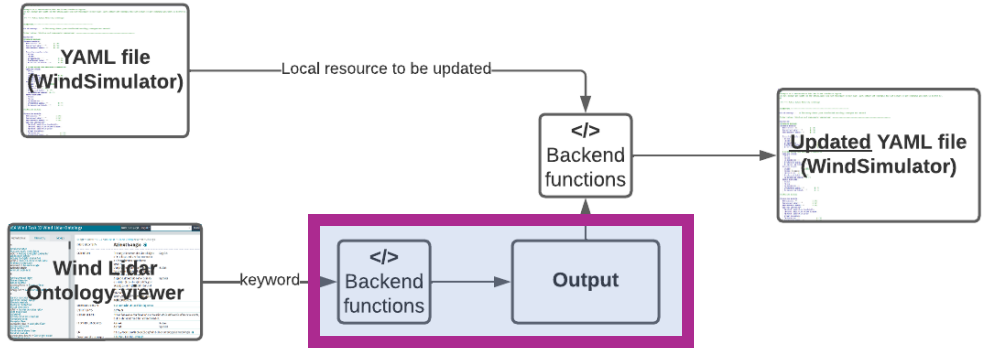
Visit https://data.windenergy.dtu.dk/ontologies/view/ontolidar/en/







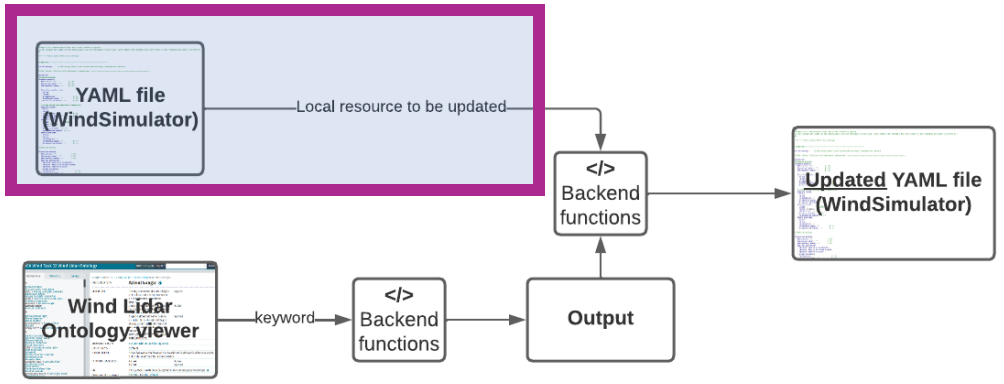
Jupyter notebook



The output

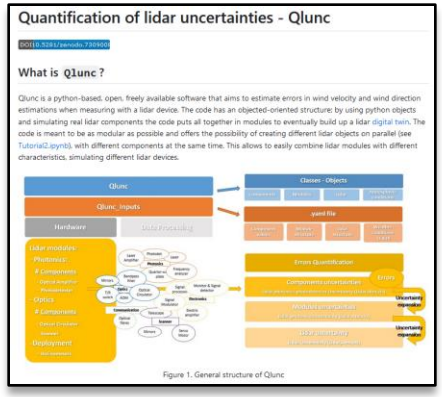
```
@prefix ontolidar: <http://vocab.ieawindtask32.org/wind-lidar-ontology/> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

ontolidar:AzimuthAngle
  skos:editorialNote "Il vettore di riferimento dell'angolo di azimith è spesso quello che indica il nord geografico. Un qualsiasi altro vettore, in realtà, potrebbe analogamente servire allo scopo
  skos:altLabel "Azimuth"@en ;
  skos:definition "Angulo subtendido entre la línea de visión (line-of-sight o LOS, por sus siglas en inglés) del lidar y el vector de referencia del plano de referencia."@es, "L'angolo fra la dire
  skos:prefLabel "Azimut"@it, "Azimut"@es, "Azimuth angle"@en, "方位角"@cn ;
  skos:inScheme ontolidar: ;
  ontolidar:units "degrees"@en ;
  skos:broader ontolidar:ScannerAzimuthPositioningServo ;
  a skos:Concept .

ontolidar:
  skos:prefLabel "IEA Wind Task 32 Wind Lidar Ontology"@en ;
  a skos:ConceptScheme .

ontolidar:ScannerAzimuthPositioningServo
  skos:prefLabel "扫描器方位定位伺服"@cn, "Servomotor de posicionamiento azimut del escáner"@es, "Servomotore per la scansione nella direzione azimutale"@it, "Scanner azimuth positioning servo"@en ;
  a skos:Concept ;
  skos:narrower ontolidar:AzimuthAngle .
```

Jupyter notebook



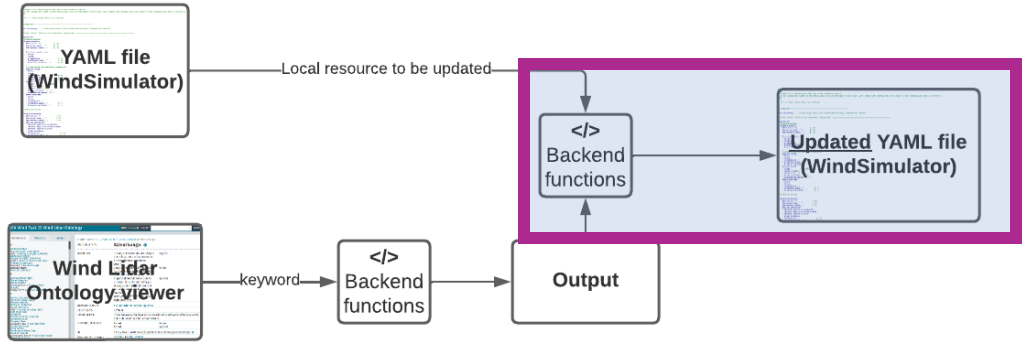
The application: Wind simulator

```
# Ontology group.
###
# Example of a standardised file for lidar simulator inputs.
# Do not change the names of the definitions nor the structure of the file. Just change the concepts and the fields of the concepts you want to access to.
###

# (*) --> Value taken from the ontology


# DIRECTORY:-----------------------------------------------------

Main directory: .    # Directory where your downloaded ontology concepts are stored

# Lidar values. Modules and components parameters: ---------------------------------------------------------

Components:
  #Scanner module:
  Scanner module:
    Definition: ''            # (%)
    Preferred Label: ''       # (%)
    Alternative Label: ''     # (%)

    Scanning sample rate:
      Value:
      Units:
      Definition: ''              # (%)
      Preferred Label: ''         # (%)
      Alternative Label: ''       # (%)

    # Lidar range and pointing parameters
    Opening angle:
      Value:
      Units:
      Definition: ''              # (%)
      Preferred Label: ''         # (*)
      Alternative Label: ''       # (*)
    Azimuth angle:
      Value:          #[degrees]
      Units: Degrees
      Definition:  # (%)
      Preferred Label:  # (*)
      Alternative Label:  # (*)
    Focus distance:
      Value:
      Units:
      Definition: ''
      Preferred Label: ''         # (*)
```



iea wind

Jupyter notebook



The application: Wind simulator

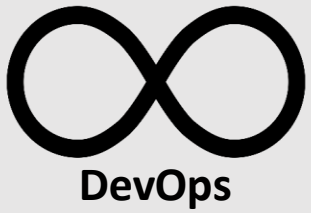
```
# Ontology group.
###
# Example of a standardised file for lidar simulator inputs.
# Do not change the names of the definitions nor the structure of the file. Just change the concepts and the fields of the concepts you want to access to.
###

# (*) --> Value taken from the ontology


# DIRECTORY:-----------------------------------------------------

Main directory: .    # Directory where your downloaded ontology concepts are stored

# Lidar values. Modules and components parameters: ---------------------------------------------------

Components:
  #Scanner module:
  Scanner module:
    Definition: ''            # (%)
    Preferred Label: ''       # (%)
    Alternative Label: ''     # (%)

    Scanning sample rate:
      Value:
      Units:
      Definition: ''              # (%)
      Preferred Label: ''         # (%)
      Alternative Label: ''       # (%)

    # Lidar range and pointing parameters
    Opening angle:
      Value:
      Units:
      Definition: ''              # (%)
      Preferred Label: ''         # (*)
      Alternative Label: ''       # (*)
    Azimuth angle:
      Value:          #[degrees]
      Units: Degrees
      Definition: VAD is a method of analyzing data from a complete conical scan whereby
        many closely spaced azimuthal points may be sampled by the lidar, and the
        data are used to estimate the wind speed at each height using a statistical
        fitting method. # (%)
      Preferred Label:  # (*)
      Alternative Label: VAD # (*)
    Focus distance:
      Value:
      Units:
      Definition: ''
      Preferred Label: ''         # (*)
```


iea wind

WG7 – Wind Lidar Ontology Group

Supporting large-scale wind lidar deployment

Design and use



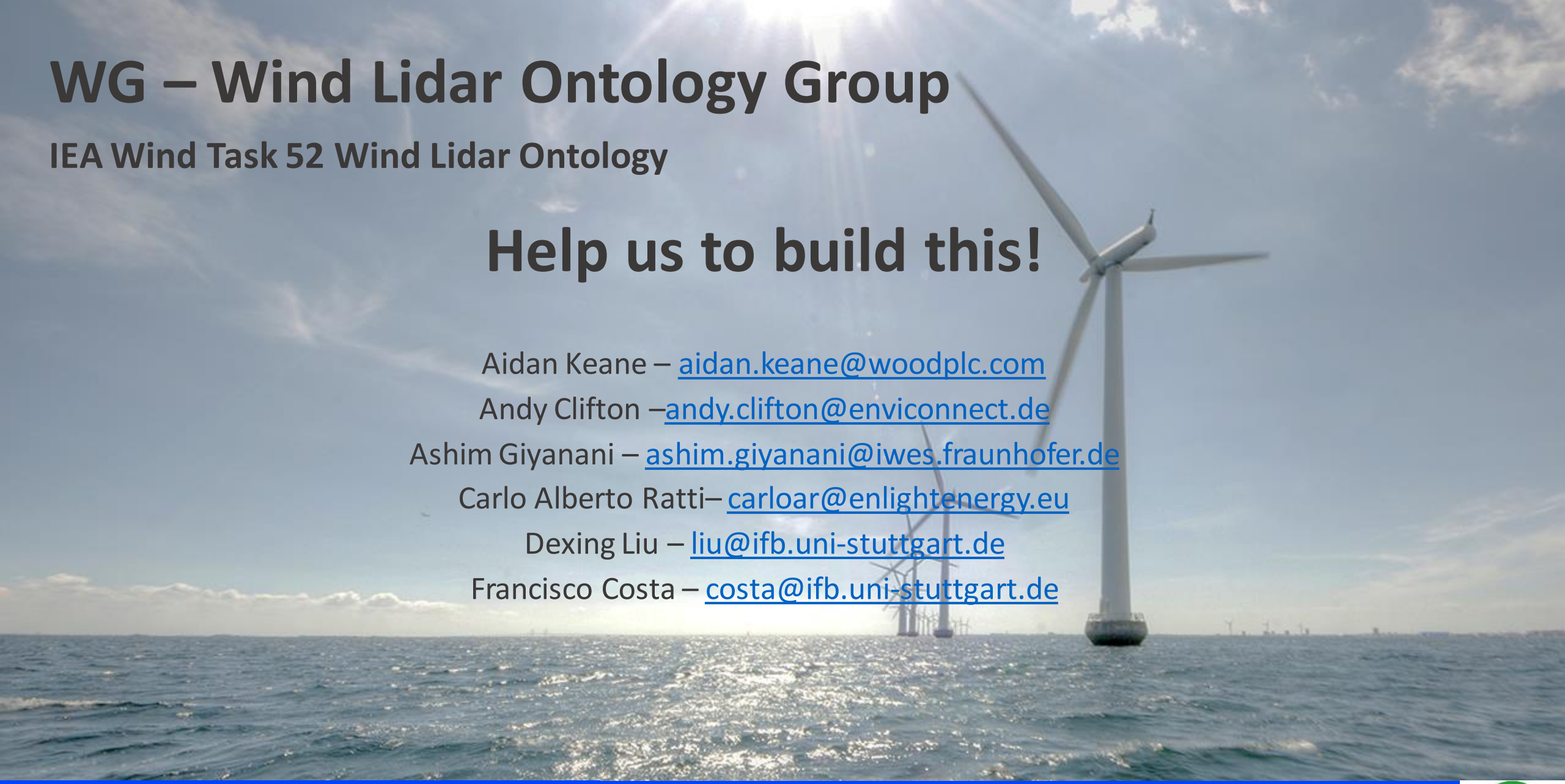
Task-specific optimization

- ✓ Lidar assisted wind turbine control
- ✓ Pre- and post-campaign preparation

Market acceptance

Fonts: iStock, Wikimedia Commons, ASP, Freeiconspng, CleanLink and EuroLab, Accessed: 04/0.8.06.2023

iea wind



WG – Wind Lidar Ontology Group

IEA Wind Task 52 Wind Lidar Ontology

Help us to build this!

Aidan Keane – aidan.keane@woodplc.com

Andy Clifton –andy.clifton@enviconnect.de

Ashim Giyanani – ashim.giyanani@iwes.fraunhofer.de

Carlo Alberto Ratti– carloar@enlightenergy.eu

Dexing Liu – liu@ifb.uni-stuttgart.de

Francisco Costa – costa@ifb.uni-stuttgart.de