



**Unifying Control and Verification
of Cyber-Physical Systems
(UnCoVerCPS)**

WP6 Dissemination and exploitation (Task 6.2)

D6.5 – Final version of the data management plan

WP6	D6.5 – Final version of the data management plan
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1 Introduction

The Data Management Plan (DMP) is based on the information (models, tools, and data) used in each task. UnCoVerCPS has an open access policy; the DMP has been written following the Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020 and the Guidelines on Data Management in Horizon 2020. The required information was collected among all the partners following Annex 1 provided by the European Commission in the Guidelines on Data Management in Horizon 2020. The template covers the following points:

- Identification;
- Description;
- Standards and metadata;
- Sharing policy;
- Archiving and preservation.

The aim of the consortium is to implement structures that ensure open-access of scientific results, software tools, and benchmark examples.

2 Elements of the UnCoVerCPS data management policy

These tables below summarize the data, models, and tools that have been produced. The shared information establishes the basis for the validation of each use case of the project. It should be noted that the scale of each element may not directly correspond to its end volume, as the latter depends on the format of data collected.

2.1 Technische Universität München

Element No.	1
Reference	<i>TUM_MP1</i>
Name	Annotated motion primitives
Origin	Generated from MATLAB
Nature	Data points and sets
Scale	Medium
Interested users	People performing motion planning
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Can be integrated in most motion planners
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	Not required
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	100 MB
Associated costs	None
Costs coverage	N/a

Table 1: *TUM_MP1*

Element No.	2
Reference	<i>TUM_MT1</i>
Name	Manipulator trajectories
Origin	Recorded from experiments with a robotic manipulator for safe human-robot interaction
Nature	Joint angles and velocities over time
Scale	Medium
Interested users	People researching in human-robot collaboration
Underpins scientific publications	No
Existence of similar data	Yes
Integration and/ or reuse	Data can be compared, but not integrated
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination	Website
Software/tools to enable re-use	Not required
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	1 GB
Associated costs	None
Costs coverage	N/a

Table 2: *TUM_MT1*

Element No.	3
Reference	<i>TUM_CORA1</i>
Name	CORA
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
Interested users	People performing formal verification of CPSs
Underpins scientific publications	Yes
Existence of similar data	N/a (software tool)
Integration and/ or reuse	Integrated in MATLAB
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination	Website
Software/tools to enable re-use	CORA is already a tool
Dissemination Level	Open access
Repository	Bitbucket
Storing time	12/01/2022
Approximated end volume	10 MB
Associated costs	None
Costs coverage	N/a

Table 3: *TUM_CORA1*

Element No.	3
Reference	<i>TUM_CommonRoad1</i>
Name	Traffic scenarios for trajectory planning of automated vehicles
Origin	Various
Nature	Complete traffic situations
Scale	medium
Interested users	People performing motion planning
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Platform independent (XML format)
Standards and Metadata	Created by ourselves
Access procedures	Website: commonroad.in.tum.de
Embargo period	N/a
Dissemination	Website
Software/tools to enable re-use	Not required
Dissemination Level	Open access
Repository	GitLab
Storing time	12/01/2030
Approximated end volume	1 GB
Associated costs	None
Costs coverage	N/a

Table 4: *TUM.CORA1*

2.2 Université Joseph Fourier Grenoble 1

Element No.	1
Reference	<i>UJF_SX1</i>
Name	SpaceEx
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
Interested users	Academia, researchers
Underpins scientific publications	Yes
Existence of similar data	N/a (software tool)
Integration and/ or reuse	N/a
Standards and Metadata	Not existing
Access procedures	Available at spaceex.imag.fr
Embargo period	None
Dissemination method	Website
Software/tools to enable re-use	None
Dissemination Level	Open access
Repository	Institutional (forge.imag.fr)
Storing time	31/12/2020
Approximated end volume	50 MB
Associated costs	None
Costs coverage	N/a

Table 5: *UJF_SX1*

2.3 Universität Kassel

Element No.	2
Reference	<i>UKS_Con1</i>
Name	Control Strategies
Origin	Generated from MATLAB
Nature	Algorithm
Scale	Scalable
Interested users	Partners using control algorithms
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Implemented in MATLAB
Standards and Metadata	Not existing
Access procedures	Will be made available on website
Embargo period	Available after publication
Dissemination method	E-mail
Software/tools to enable re-use	MATLAB
Dissemination Level	Restricted to project partners until publication
Repository	N/a
Storing time	31.12.2020
Approximated end volume	< 10MB
Associated costs	None
Costs coverage	N/a

Table 6: *UKS_Con1*

2.4 Politecnico di Milano

Element No.	1
Reference	<i>PoliMi_MG1</i>
Name	Microgrid data
Origin	Measured and generated from MATLAB
Nature	Data points
Scale	Medium
Interested users	Researchers working on microgrid energy management
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Can be integrated in larger microgrid units
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	Not required
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	6 MB
Associated costs	None
Costs coverage	N/a

Table 7: *PoliMi_MG1*

2.5 GE Global Research Europe

Element No.	1
Reference	<i>GEGR_Model1</i>
Name	MATLAB/Simulink model of wind turbine dynamics
Origin	Designed in MATLAB/Simulink
Nature	MATLAB/Simulink Model
Scale	Small
Interested users	All project partners working on verification
Underpins scientific publications	Yes
Existence of similar data	Yes, but existing models are typically more complex
Integration and/ or reuse	Can be reused with verification tools accepting MATLAB/Simulink models
Standards and Metadata	N/a
Access procedures	Made available to project partners upon request
Embargo period	N/a
Dissemination method	Limited to consortium partners
Software/tools to enable re-use	MATLAB/Simulink
Dissemination Level	Limited to consortium partners
Repository	GE-internal repository
Storing time	December 2019
Approximated end volume	1 MB
Associated costs	N/a
Costs coverage	N/a

Table 8: *GEGR_Model1*

Element No.	2
Reference	<i>GEGR_Data1</i>
Name	Wind turbine load data
Origin	Generated in MATLAB/Simulink
Nature	Data on wind, turbine power, turbine speed, turbine loads
Scale	Medium
Interested users	All project partners working on verification
Underpins scientific publications	Yes
Existence of similar data	Yes, but typically based on more complex models
Integration and/ or reuse	Reuse in verification tools
Standards and Metadata	N/a
Access procedures	Made available to project partners upon request
Embargo period	N/a
Dissemination method	Limited to consortium partners
Software/tools to enable re-use	MATLAB/Simulink
Dissemination Level	Limited to consortium partners
Repository	GE-internal repository
Storing time	December 2019
Approximated end volume	100 MB
Associated costs	N/a
Costs coverage	N/a

Table 9: *GEGR_Data1*

2.6 Robert Bosch GmbH

Element No.	1
Reference	<i>BOSCH_Model1</i>
Name	Simulink Model of an Electro-Mechanical Brake
Origin	Designed in Simulink
Nature	Simulink Model
Scale	Small
Interested users	People working on (simulation-based) verification
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Can be used with verification tools accepting Simulink models
Standards and Metadata	Not existing
Access procedures	Download from ARCH website
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	Mathworks Simulink
Dissemination Level	Open access
Repository	ARCH website (linked from UnCoVerCPS)
Storing time	12/01/2022
Approximated end volume	1 MB
Associated costs	None
Costs coverage	N/a

Table 10: *BOSCH_Model1*

Element No.	2
Reference	<i>BOSCH_Model2</i>
Name	SpaceEx Models of an Electro-Mechanical Brake with Conformance Monitor
Origin	Designed in SpaceEx
Nature	SpaceEx Model
Scale	Small
Interested users	People working on formal verification
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Can be used with verification tools accepting SpaceEx models
Standards and Metadata	Not existing
Access procedures	Download from UnCoVerCPS website
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	SpaceEx
Dissemination Level	Open access (for distribution refer to <code>LICENSE.txt</code>)
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	6 KB
Associated costs	None
Costs coverage	N/a

Table 11: *BOSCH_Model2*

Element No.	3
Reference	<i>BOSCH_Tests1</i>
Name	Parametric test case instances
Origin	Generated with MATLAB
Nature	MATLAB mat files
Scale	Medium
Interested users	People working on test case generation for conformance testing
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	The instances from the parametric test cases for conformance testing in the automated driving use case can be loaded using MATLAB. For more details and associated models see [2] and deliverable D1.3 [1]
Standards and Metadata	Not existing
Access procedures	Download from UnCoVerCPS website
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	MATLAB
Dissemination Level	Open access (for distribution refer to <code>LICENSE.txt</code>)
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	6 KB
Associated costs	None
Costs coverage	N/a

Table 12: *BOSCH_Tests1*

2.7 Esterel Technologies

Element No.	1
Reference	<i>ET_SCADE</i>
Name	SCADE
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
Interested users	People working on code generation
Underpins scientific publications	Yes
Existence of similar data	N/a (software tool)
Integration and/ or reuse	API access to models
Standards and Metadata	Scade
Access procedures	Licensing, academic access
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	SCADE
Dissemination Level	Commercial access or Academics programs
Repository	Proprietary
Storing time	> 20years
Approximated end volume	N/a
Associated costs	N/a
Costs coverage	N/a

Table 13: *ET_SCADE*

Element No.	2
Reference	<i>ET_SCADE_HYBRID</i>
Name	Scade Hybrid
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
To whom it could be useful	Code generation
Underpins scientific publications	yes
Existence of similar data	N/a (software tool)
Possibilities for integration and/or reuse	API access to models
Standards and Metadata	Scade Hybrid
Access procedures	Licensing, academic access
Embargo periods	n/a
Technical mechanisms for dissemination	ftp, email
Software and other tools to enable re-use	SCADE
Access widely open or restricted to specific groups	Commercial access or Academics programs
Repository	Proprietary
Data set will not be shared	n/a
How and for how long data should be stored	> 20years
Approximated end volume	n/a
Associated costs	n/a
Costs coverage	n/a

Table 14: *ET_SCADE_HYBRID*

Element No.	3
Reference	<i>ET_SX2SH</i>
Name	sx2sh
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
To whom it could be useful	Code generation
Underpins scientific publications	yes
Existence of similar data	N/a (software tool)
Possibilities for integration and/or reuse	SpaceEx format
Standards and Metadata	SpaceEx / Scade Hybrid
Access procedures	Licensing, academic access
Embargo periods	n/a
Technical mechanisms for dissemination	ftp, email
Software and other tools to enable re-use	SpaceEx / SCADE
Access widely open or restricted to specific groups	Academics programs
Repository	Proprietary
Data set will not be shared	n/a
How and for how long data should be stored	> 20 years
Approximated end volume	n/a
Associated costs	n/a
Costs coverage	n/a

Table 15: *ET_SX2SH*

2.8 Deutsches Zentrum für Luft- und Raumfahrt

Element No.	1
Reference	<i>DLR_MA_1</i>
Name	Maneuver Automata
Origin	Generated from MATLAB
Nature	Datapoints, sets and graph structures
Scale	Big
Interested users	People researching in motion planning
Underpins scientific publications	Yes
Existence of similar data	No
Integration and/ or reuse	Low probability of reuse
Standards and Metadata	Not existing
Access procedures	Request from author
Embargo period	N/a
Dissemination method	Reduced version will be placed on UnCoVerCPS website
Software/tools to enable re-use	MATLAB
Dissemination Level	Open access
Repository	UnCoVerCPS website, DLR SVN
Storing time	12/01/2022
Approximated end volume	10 GB
Associated costs	None
Costs coverage	N/a

Table 16: *DLR_MA_1*

Element No.	2
Reference	<i>DLR_TEST_1</i>
Name	Vehicle Trajectories
Origin	Recorded during testdrives with one or two vehicles
Nature	Datapoints
Scale	Medium
Interested users	People researching in driver assistance systems, vehicle automation, vehicle cooperation, Car2X
Underpins scientific publications	Yes
Existence of similar data	Yes
Integration and/ or reuse	Data can be compared, but not integrated
Standards and Metadata	Not existing
Access procedures	Download from website or request from author
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	MATLAB
Dissemination Level	Open access
Repository	UnCoVerCPS website, DLR SVN
Storing time	12/01/2022
Approximated end volume	5 GB
Associated costs	None
Costs coverage	N/a

Table 17: *DLR_TEST_1*

Element No.	3
Reference	<i>DLR_TEST_2</i>
Name	Communication Messages
Origin	Recorded during testdrives with one or two vehicles
Nature	Sent and received messages of Car2Car-Communication/Vehicle cooperation
Scale	Medium
Interested users	People researching in driver assistance systems, vehicle automation, vehicle cooperation, Car2X
Underpins scientific publications	Yes
Existence of similar data	Yes
Integration and/ or reuse	Data can be compared, but not integrated
Standards and Metadata	Not existing
Access procedures	Download from website or request from author
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	MATLAB
Dissemination Level	Open access
Repository	UnCoVerCPS website, DLR SVN
Storing time	12/01/2022
Approximated end volume	1 GB
Associated costs	None
Costs coverage	N/a

Table 18: *DLR_TEST_2*

2.9 Fundacion Tecnia Research & Innovation

Element No.	1
Reference	<i>TCNL_TVD</i>
Name	Twizy Vehicle Data
Origin	Recorded from experiments with TCNL's automated vehicle
Nature	Vehicle's trajectory, accelerations (lateral, longitudinal), speed, yaw as well as control commands leading to these values. Recorded from vehicle's CAN bus, DGPS and IMU.
Scale	Medium
Interested users	Research group in automated vehicles
Underpins scientific publications	No
Existence of similar data	Yes
Integration and/ or reuse	Data was used in the vehicle identification
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	Matlab/Simulink
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	10 MB
Associated costs	None
Costs coverage	N/a

Table 19: *TCNL_TVD*

Element No.	2
Reference	<i>TCNL_DTCD</i>
Name	Dynacar Trace Conformance Data
Origin	Recorded from Multi-body Dynacar Simulator. Data used in the trace conformance testing of the Tecnalia vehicle
Nature	The reference data is based on high fidelity simulations of a multi-body vehicle model.
Scale	Medium
Interested users	Conformance and validation test researchers
Underpins scientific publications	No
Existence of similar data	No
Integration and/ or reuse	Data can be compared
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	Matlab/Simulink and Dynacar
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	15 MB
Associated costs	None
Costs coverage	N/a

Table 20: *TCNL_DTCD*

Element No.	3
Reference	<i>TCNL_DCLCV</i>
Name	Dynacar Closed Loop Controller Validation
Origin	Recorded from our Automated driving testing tool, based on the Dynacar Simulator. Data used to validate different controllers.
Nature	The reference data is based on high fidelity simulations and real vehicles for the Automated Driving Use Case.
Scale	Medium
Interested users	Control research groups
Underpins scientific publications	Yes
Existence of similar data	Yes
Integration and/ or reuse	Data can be compared
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	UnCoVerCPS website
Software/tools to enable re-use	Matlab/Simulink and Dynacar
Dissemination Level	Open access
Repository	UnCoVerCPS website
Storing time	12/01/2022
Approximated end volume	10 MB
Associated costs	None
Costs coverage	N/a

Table 21: *TCNL_DCLCV*

2.10 R.U. Robots Ltd

Element No.	1
Reference	<i>RUR_SS1</i>
Name	Safety System for Human-Robot Colaboration Test Bed
Origin	N/a (software tool)
Nature	Software
Scale	N/a (software tool)
Interested users	People performing formal verification of CPSs
Underpins scientific publications	Yes
Existence of similar data	N/a (software tool)
Integration and/ or reuse	High possibility for reuse in other control systems
Standards and Metadata	Not existing
Access procedures	Download from website or request from authors
Embargo period	N/a
Dissemination method	Website
Software/tools to enable re-use	Compiler for appropriate programming language
Dissemination Level	Open access
Repository	Not know at this stage
Storing time	12/01/2022
Approximated end volume	10 MB - estimated
Associated costs	None
Costs coverage	N/a

Table 22: *RUR_SS1*

3 Conclusions and future developments

The tables above display the current practice proposed by the consortium regarding the management of data sets, models and software tools. As UnCoVerCPS has not collected huge amounts of data during its lifespan, partners decided to include other elements apart from data sets in the data management plan. The consortium will continue to provide open access to the models and tools employed beyond the funding period of UnCoVerCPS.

References

- [1] UnCoVerCPS Deliverable D1.3: Report on Conformance Testing in the Development Process. Technical report.
- [2] M. Althoff and J. M. Dolan. Reachability computation of low-order models for the safety verification of high-order road vehicle models. In *American Control Conference, ACC 2012, Montreal, QC, Canada, June 27-29, 2012*, pages 3559–3566, 2012.