

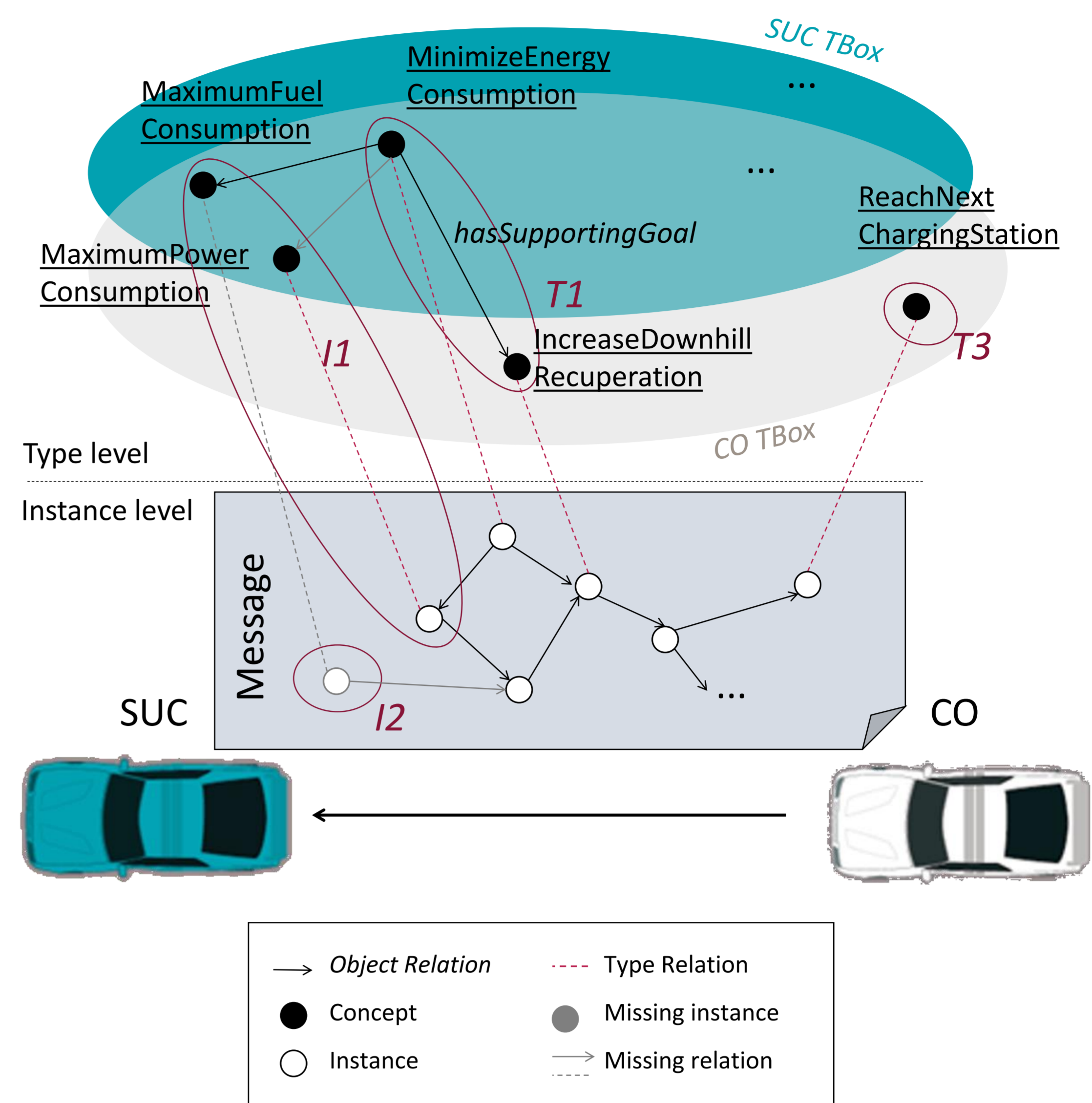
Identifying Epistemic Uncertainties in Collaborative System Groups

Motivation

- Epistemic uncertainty refers to the knowledge that is available to a system being insufficient for properly executing its functionalities
- Epistemic uncertainties are especially important in collaborative system groups since they are reliant on the exchange of information
- In the autonomous driving domain for instance, epistemic uncertainties may occur when vehicles from different manufacturers try to collaborate, e.g. by forming a platoon and exchanging the required information

Overview

- This poster presents
 - an overview of the different epistemic uncertainties that may occur on the type level and instance level, some of which are exemplarily depicted on the right-hand side and
 - an epistemic uncertainty classification scheme for runtime information exchange in collaborative system groups.
- This classification scheme facilitates the identification of relevant sources of epistemic uncertainties for a specific collaborative embedded system (CES) during requirements engineering
- The explanations make use of a running example, depicted on the right-hand side, in which messages are sent from a context object (CO), which is an electric vehicle to a system under consideration (SUC), which is a combustion engine vehicle
- Journal paper available at:
<https://link.springer.com/content/pdf/10.1007/s00450-019-00422-9.pdf>



Epistemic Uncertainties on the Type Level

- Uncertainty sources on the type level are rooted in the terminological knowledge (TBox), basically a vocabulary utilized by CESs to specify messages
- These uncertainties result from a mismatch between the TBox of the system under consideration (SUC) and the context object (CO) used for specifying and interpreting the messages to be exchanged at runtime.

T1 Known difference in scope: the CO sends the SUC a message that includes a TBox element which is not included in the SUC's TBox

T2 Unknown difference in scope: the message contains an unknown TBox element that has an unknown relation to a known TBox element

T3 Distinct scope: the message contains an unknown TBox element that has no attachment to the SUC's TBox elements

T4 Inconsistent ontological commitment: a unit of measurement, whilst known to the SUC, does not comply with the TBox

Epistemic Uncertainties on the Instance Level

- These uncertainties pertain to the actual information contained in a message, hence they occur on the instance level
- Instance level uncertainties are either situation related, i.e. a specific information contradicts the situation at hand, or non-situation related, e.g. due to a missing semantic specification

I1 Semantically inconsistent information: occurs when a message contains a value violating the semantic definition of a relation that it refers to

I2 Situationally incomplete information: a message contains a set of statements that does not satisfy the requirements of the situation at hand

I3 Situationally inconsistent information: the content of a message is inconsistent regarding the information expected by the SUC for the situation at hand

I4 Missing type membership: the message contains an information item that lacks a type membership

EURECA Classification Scheme

- The epistemic uncertainty classification scheme for runtime information exchange (EURECA) enables systematically analyzing and capturing the previously described uncertainties (see exemplarily populated table on the right-hand side)
- The first column is populated with the SUC ontology that the captured uncertainties relate to, e.g. the SUC's goal ontology
- The second column lists the concrete ontology elements that are subject to epistemic uncertainty according to the analysis performed
- A checkmark indicates which specific epistemic uncertainty has been identified for an ontology element

SUC ontology	Ontology element	Type-level uncertainty				Instance-level uncertainty			
		T1	T2	T2	T4	I1	I2	I3	I4
Goal ontology	hasSupportingGoal	x							
	DesiredStateAtDestination		x						
	ReachNextChargingStation			x					
	hasConsumption				x				
	MaximumPowerConsumption					x			
	MaximumFuelConsumption						x		
	Range							x	
	GeographicalCoordinates								x