

Understanding Misconfigurations in ROS: An Empirical Study and Current Approaches

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*First Draft of presentation for the International Symposium of
Software Testing and Analysis*



Ciências
ULisboa

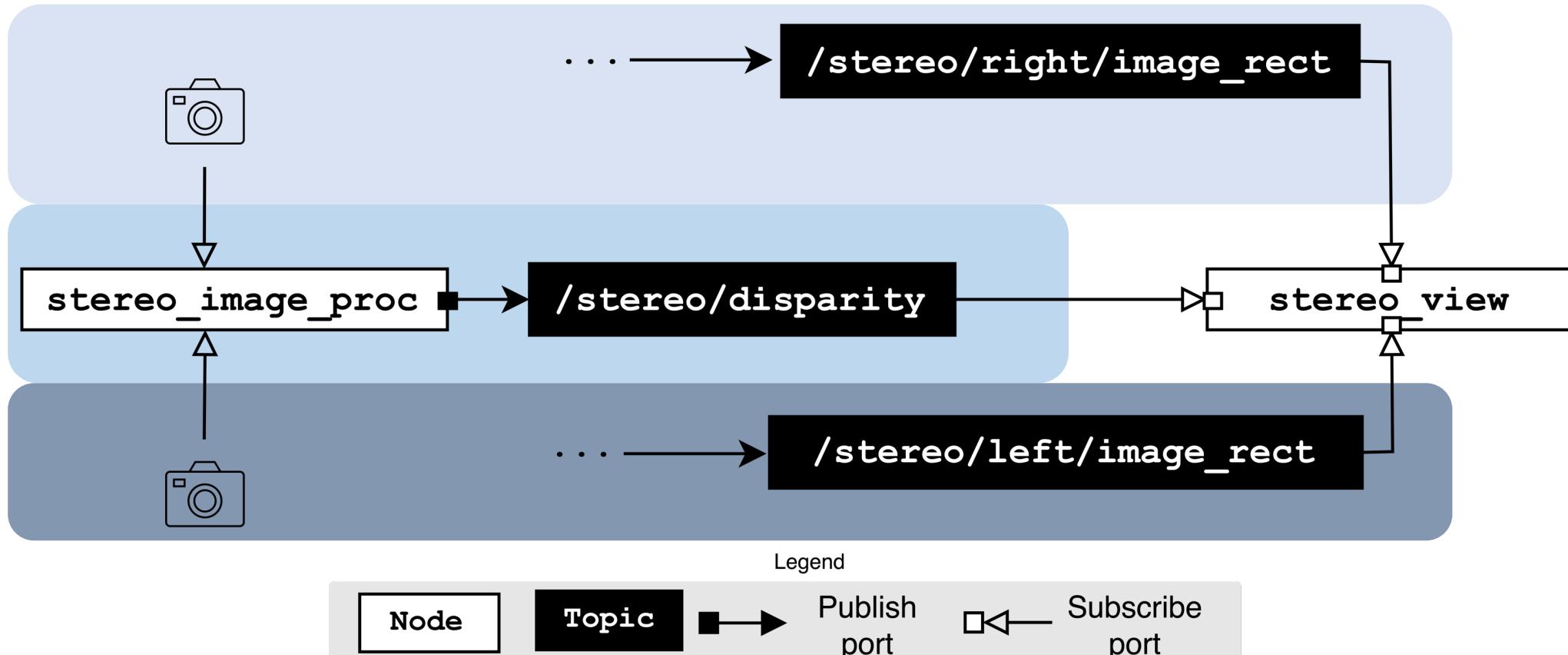


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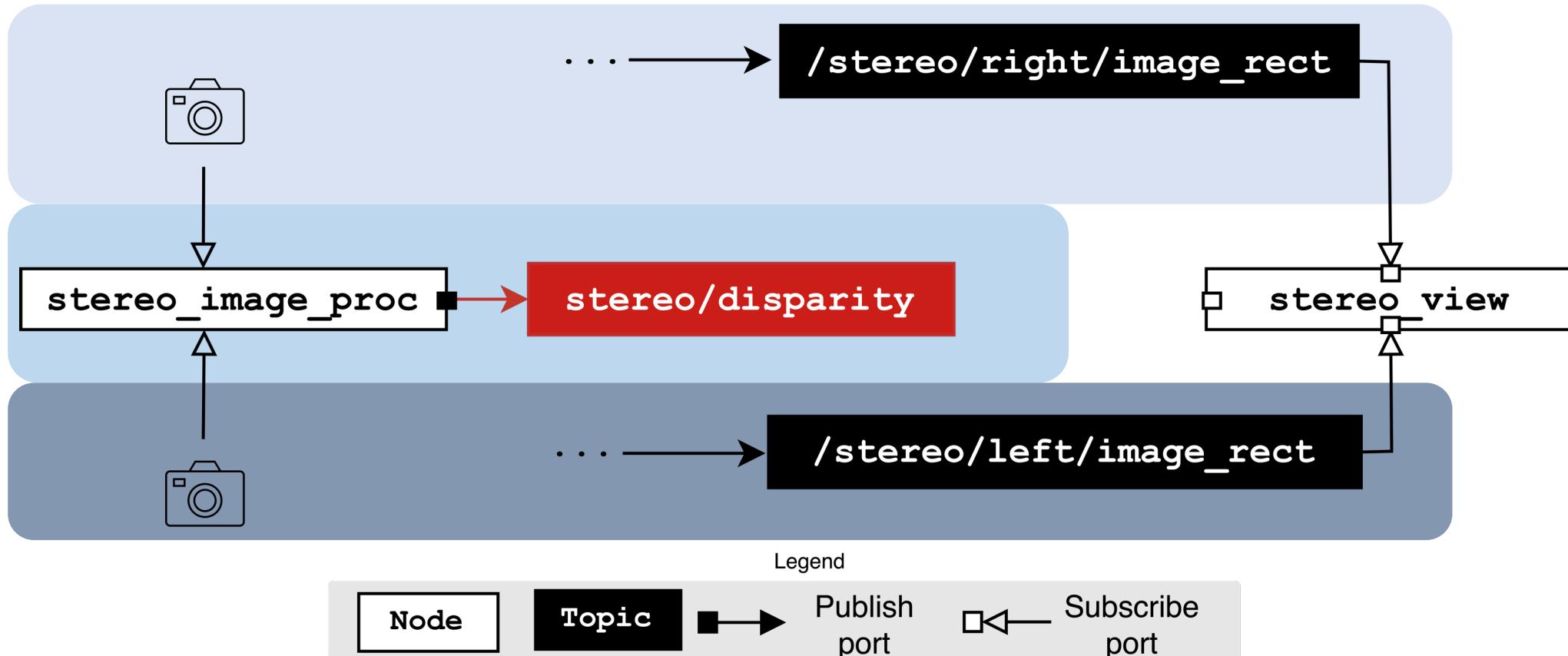


Fundação
para a Ciéncia
e a Tecnologia

ROS-based software development relies on gluing together and configuring off-the-shelf components



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Prior analysis techniques focus on the detection of well-known instances of misconfigurations in ROS

─ HAROS [Santos et al, 2021] and ROSDiscover [Timperley et al, 2022]

→ **Structural Architectural Misconfigurations**

─ PHYSFRAME [Kate et al, 2021]

→ **Frame Coordinates Errors**

─ Phys [Kate et al, 2018]

→ **Physical Unit Mismatches**

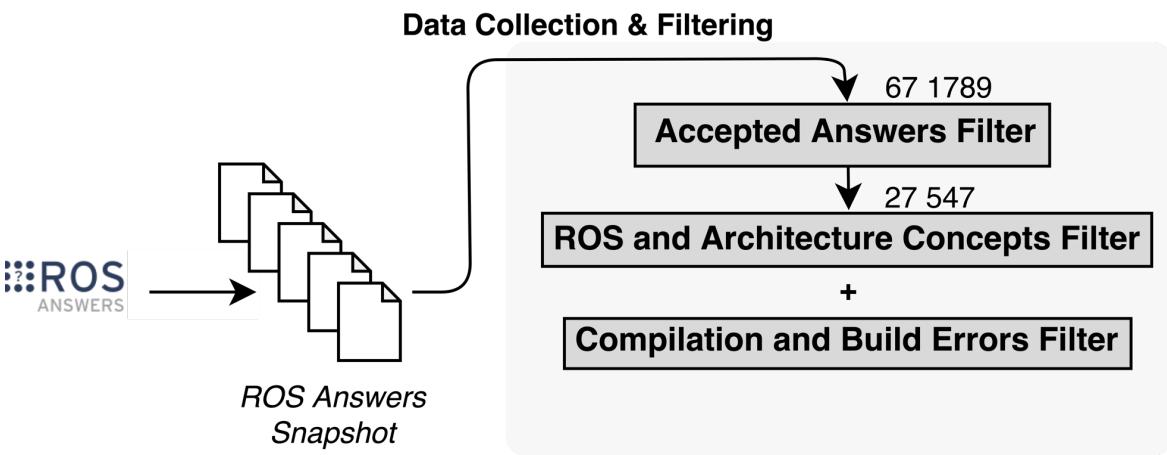
Study the types of misconfigurations that developers make and to what extent analysis tools address them

RQ1. What kinds of misconfigurations do developers make when building robot software systems with ROS?

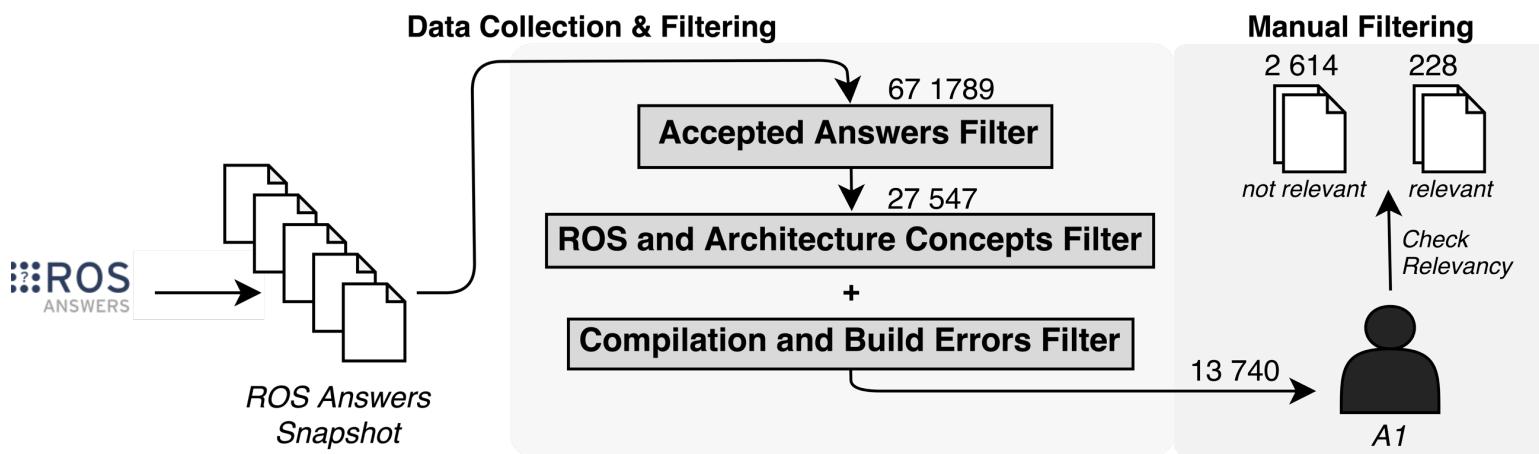
RQ2. To what extent do current techniques address these categories of misconfiguration?

**What kinds of misconfigurations
do developers make when
building robot software systems
with ROS?**

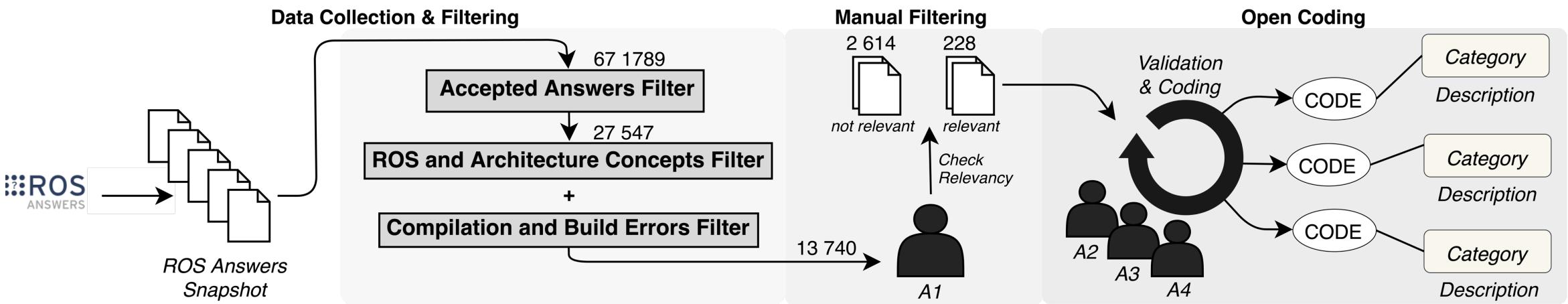
Collected and filtered ROS Answers questions,



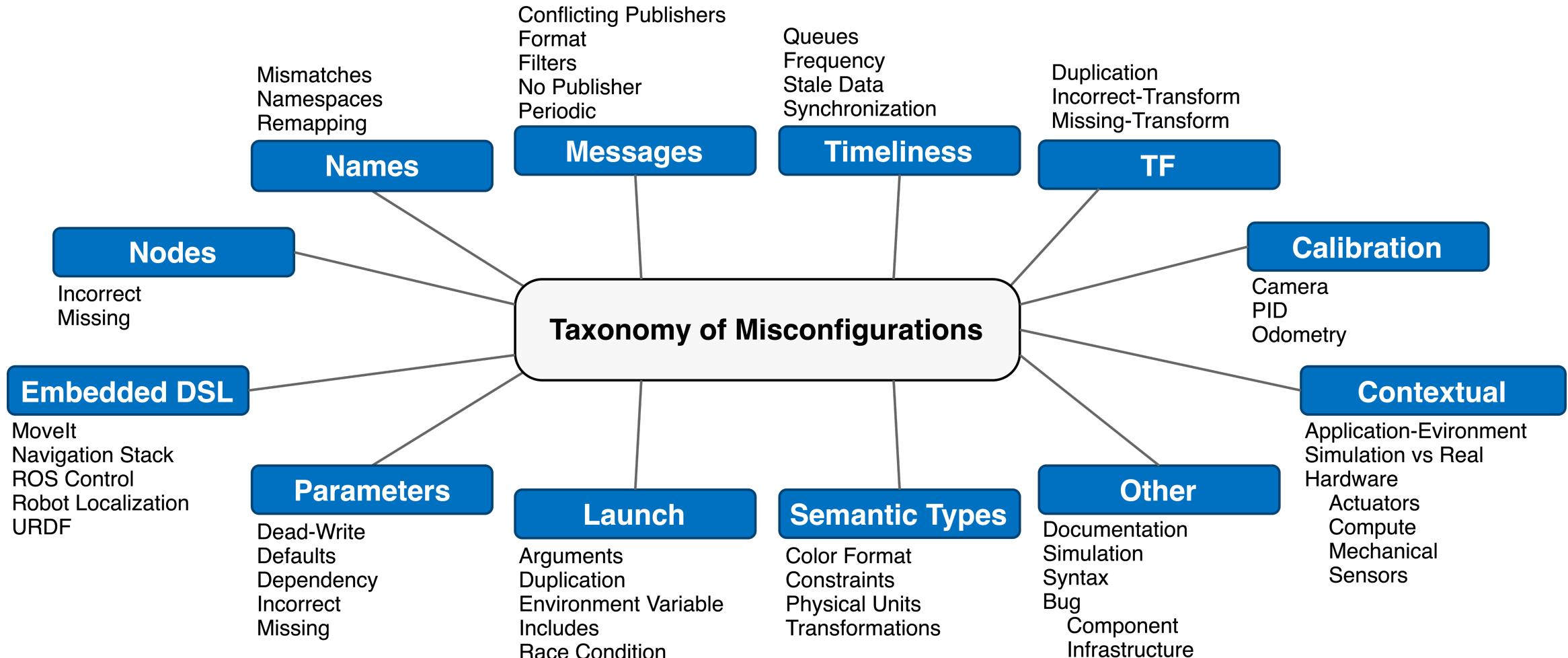
Collected and filtered ROS Answers questions, manually analyzed these,



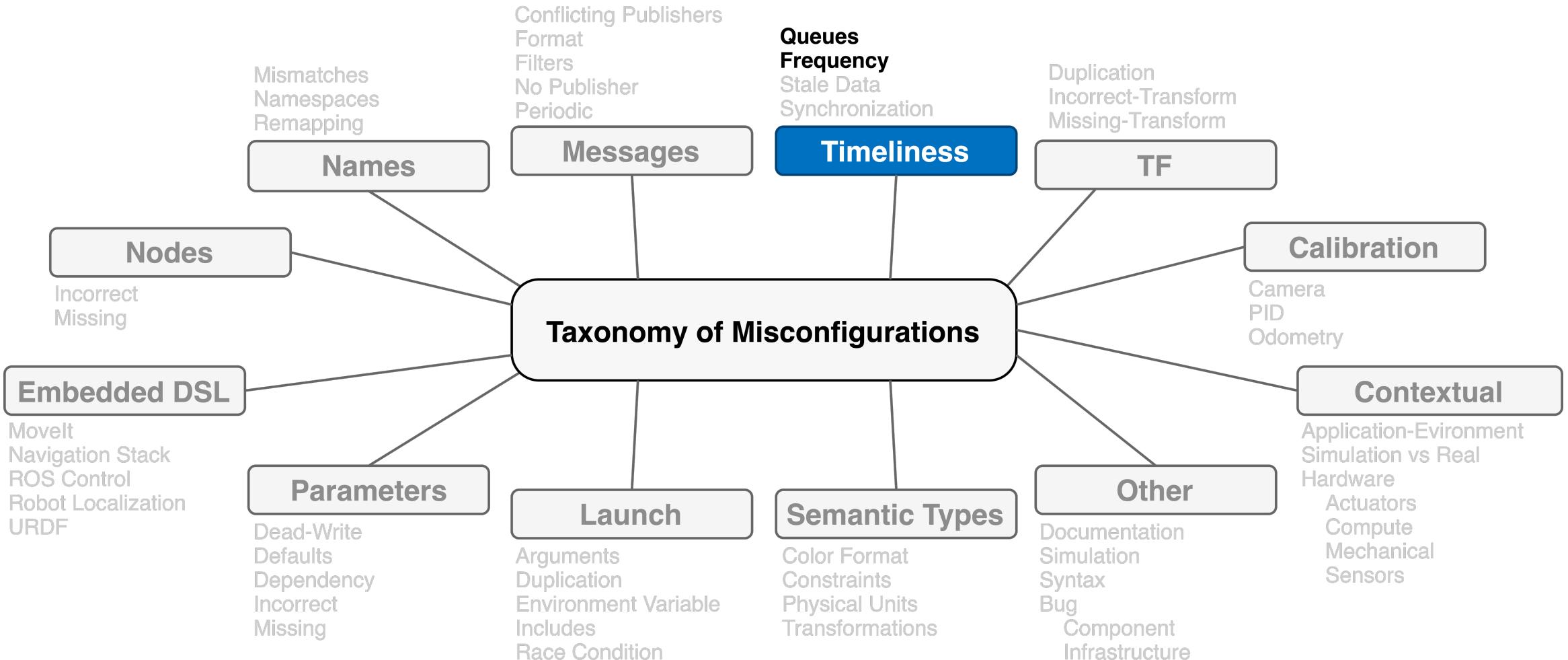
Collected and filtered ROS Answers questions, manually analyzed these, and performed open coding to obtain our taxonomy of misconfigurations



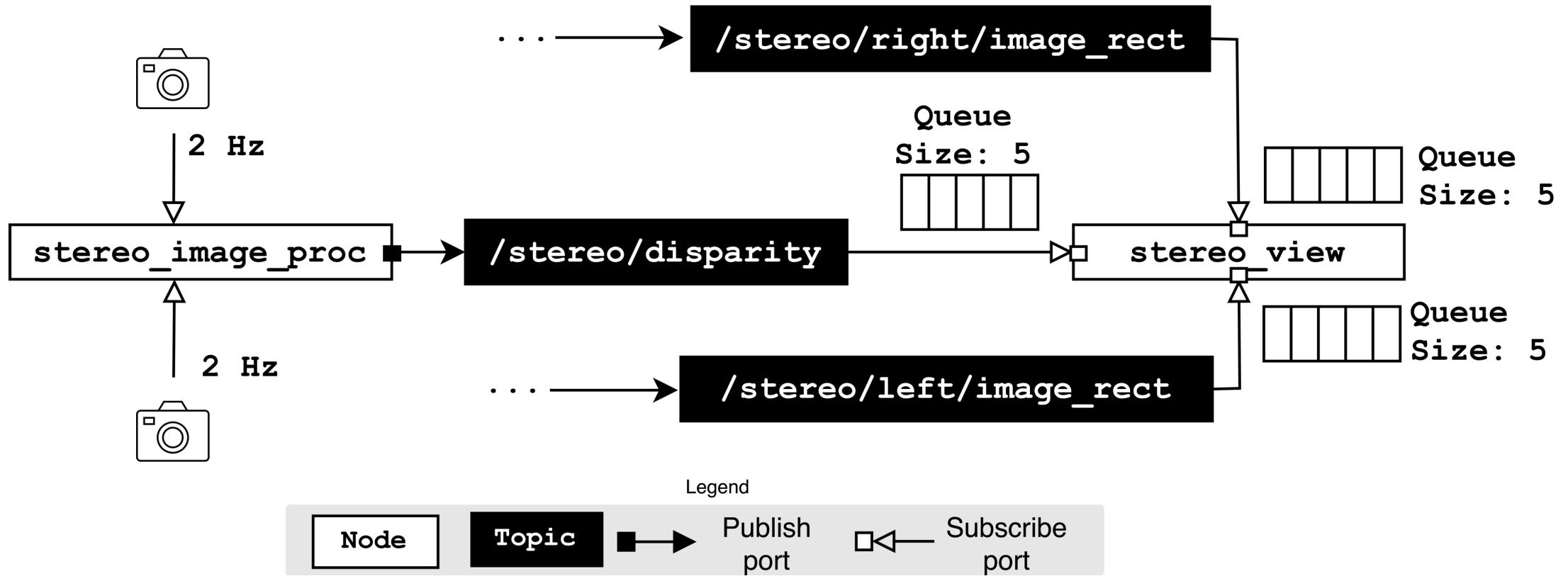
Obtained a taxonomy of 12 high-level categories and 51 subcategories of misconfigurations



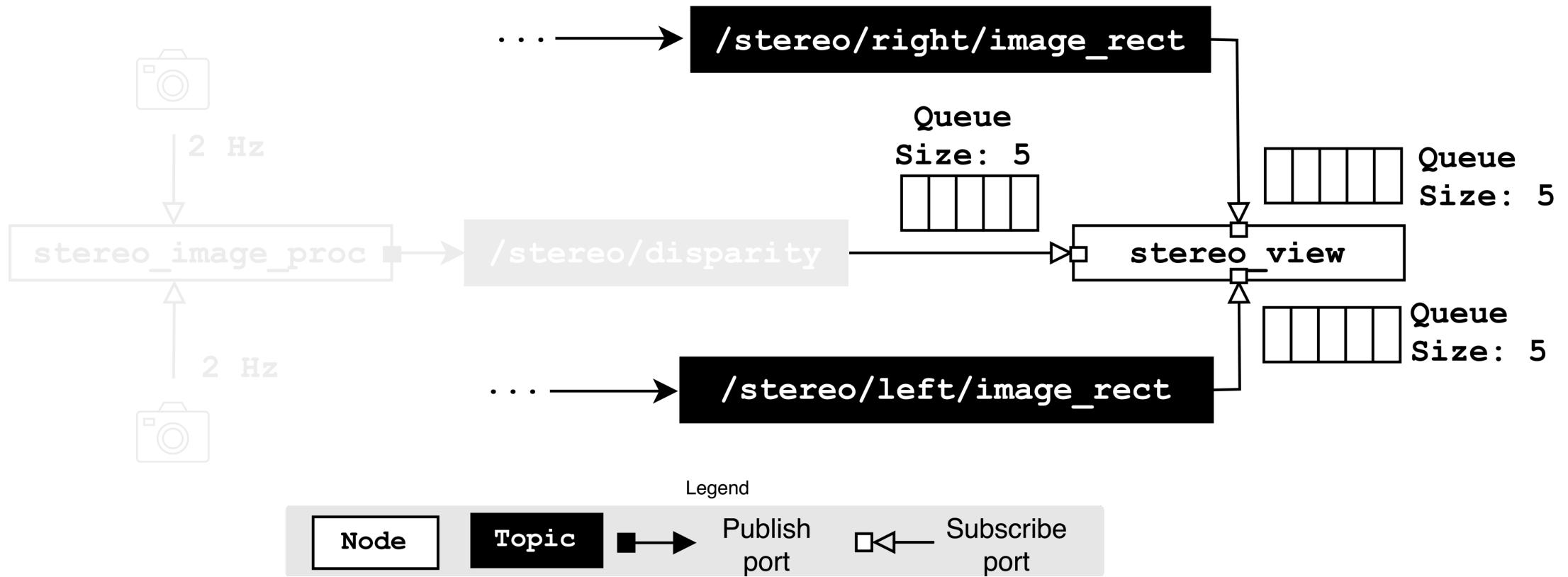
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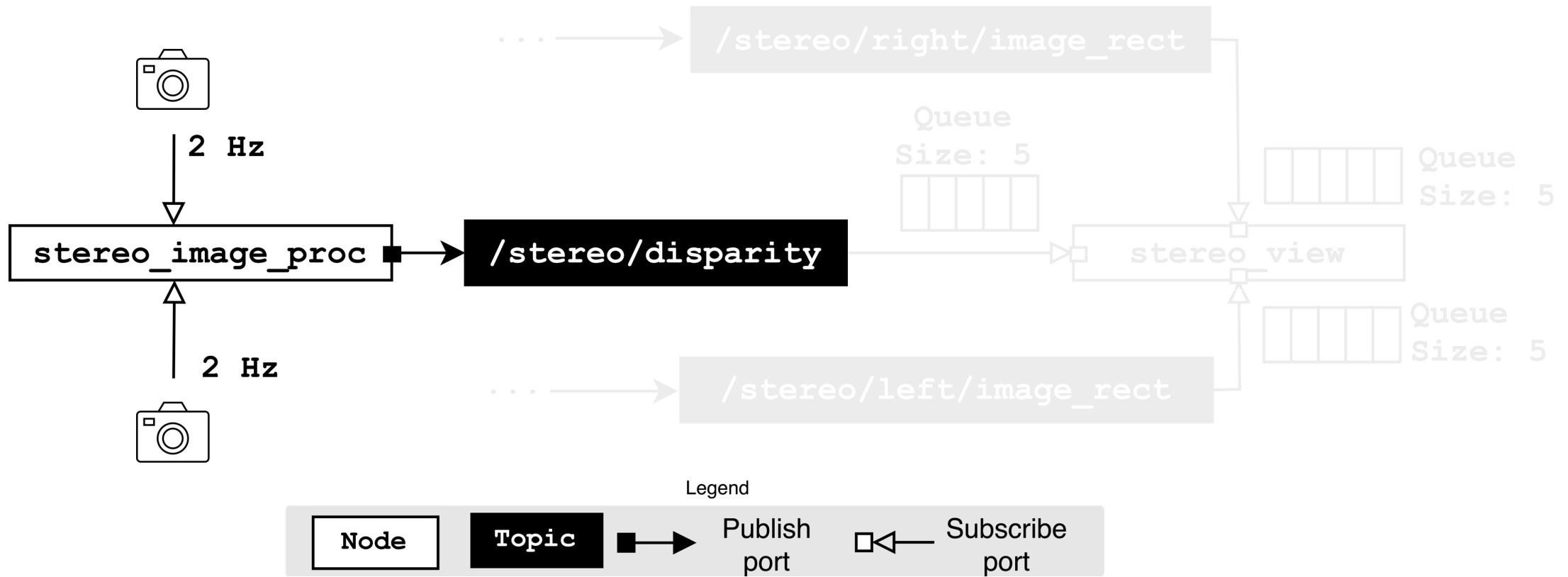
Frequency and Queues Misconfigurations



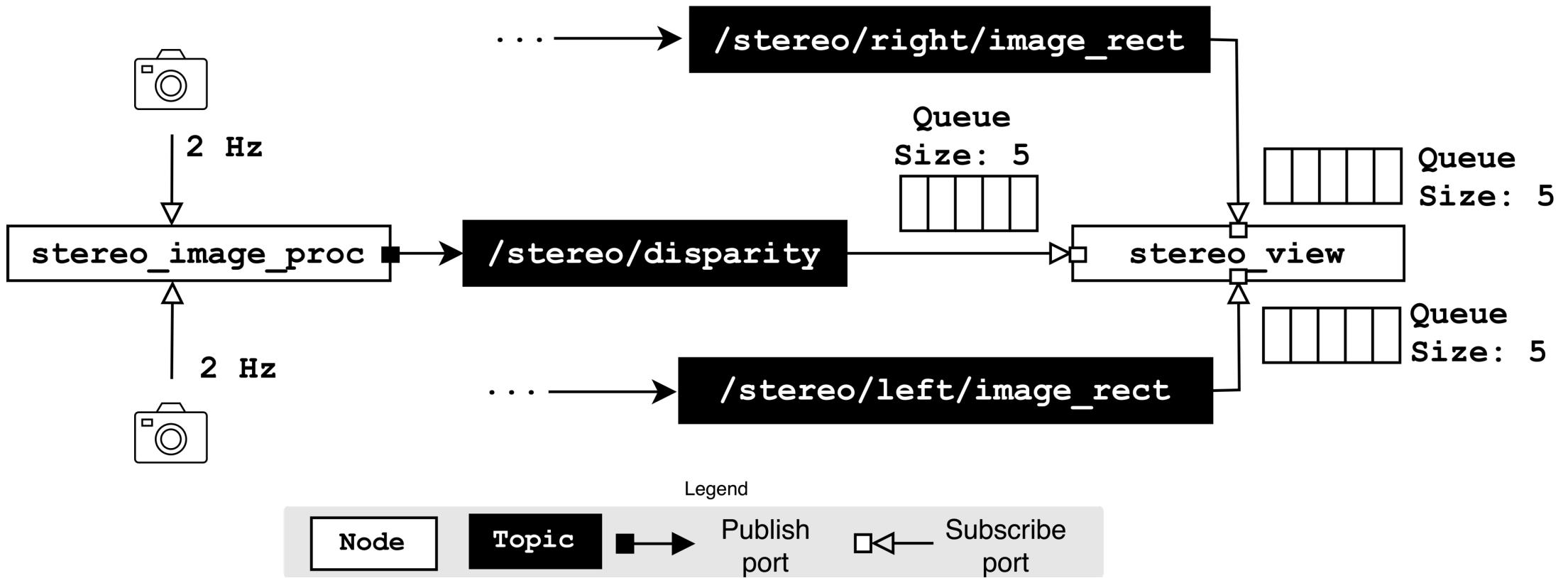
Frequency and Queues Misconfigurations



Frequency and Queues Misconfigurations



The system misses images about the real world due to the misconfigured queue sizes and frequency rates

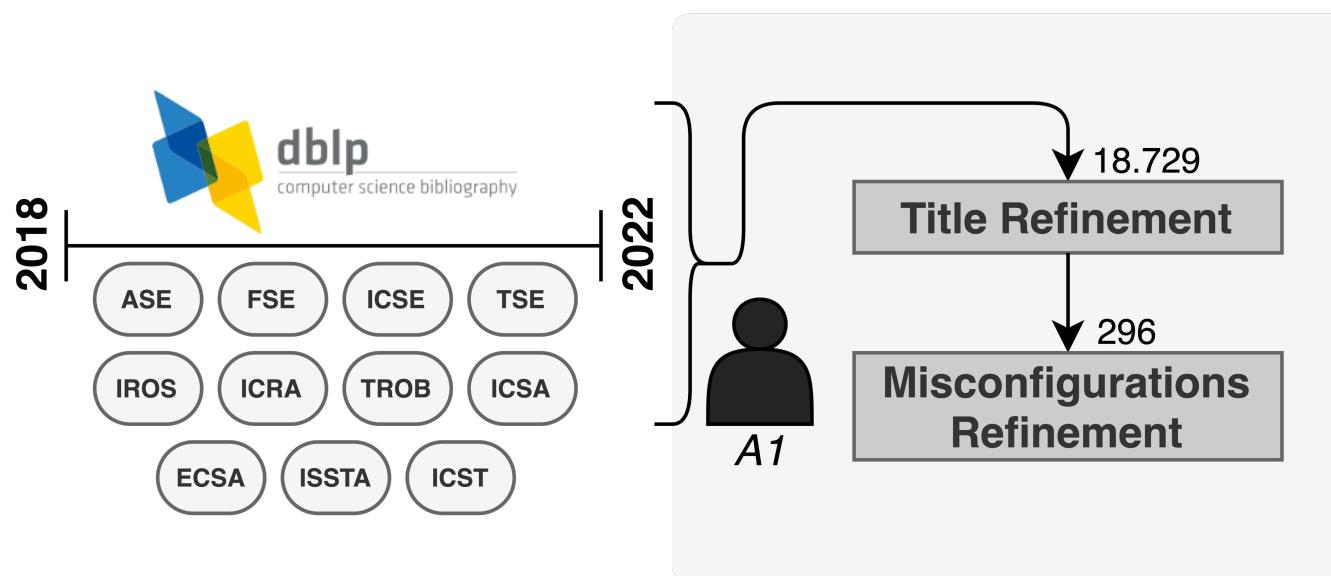


To what extent do current techniques address these categories of misconfiguration?

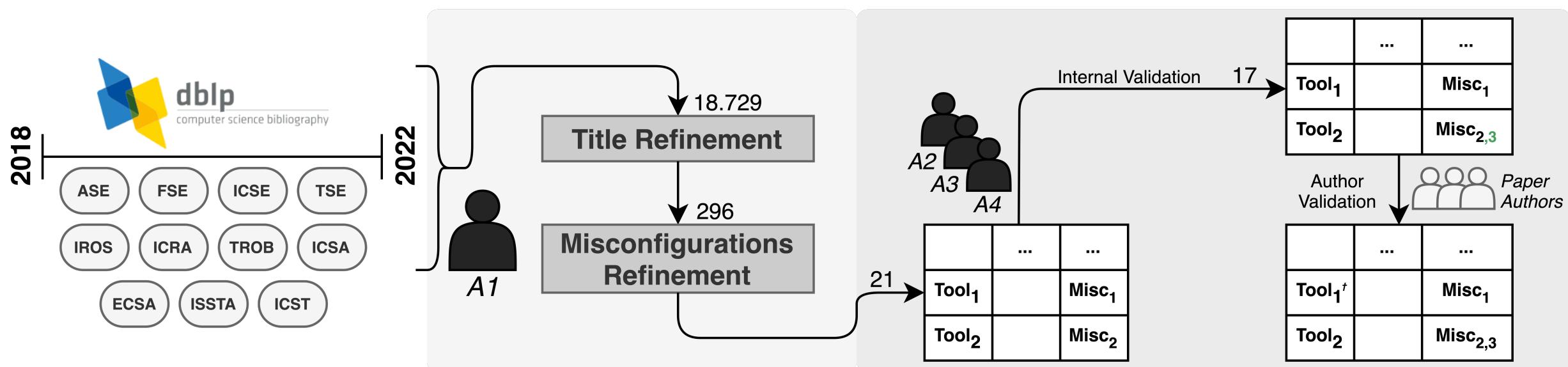
Collected related work from 11 top venues in software engineering, testing, architecture, and robotics



**Refined the relevancy of each work by checking its title,
followed by manually each paper and its ability to
address any misconfiguration**



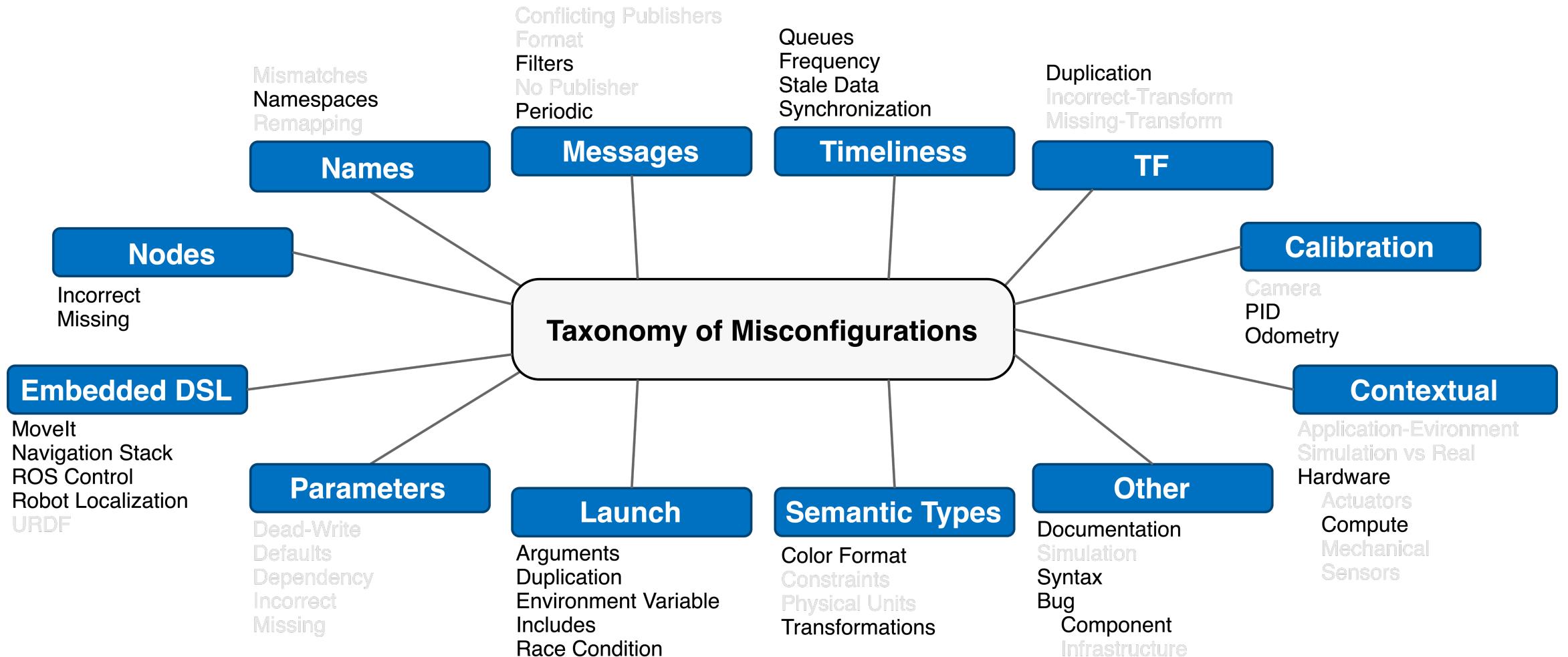
Performed an internal validation of the related work and externally validated the results with the paper authors



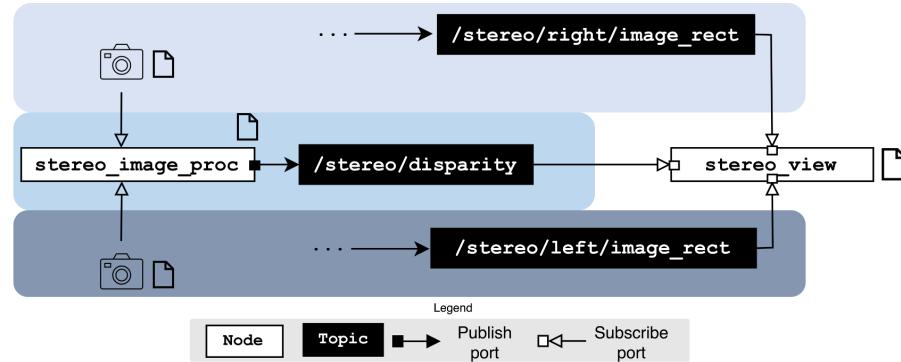
Obtained 17 relevant work where 23 subcategories of misconfigurations are addressed by current techniques

Reference	Artifact	Venue	Year	Analysis	Misconfigurations
Kate et al. [31] [†]	Phys [32]	FSE	2018	S	(T) Physical Units
Burgueño et al. [6] [†]	[42]	ICSE-RoSE	2018	S/D	(T) Physical Units (T) Constraints
Witte and Tichy [59]	[60]	ICSE-RoSE	2018	S/D	(N) Mismatches (M) No Publisher
Wüest et al. [62]	[61]	ICRA	2019	D	(P) Missing
Cramariuc et al. [12]	[11]	ICRA	2020	D	(Ca) Camera
Kate et al. [30]	PHYSFRAME [29]	FSE	2021	S	(TF) Incorrect Transform (TF) Missing Transform (P) Incorrect (P) Dependency (P) Defaults (Co)
Jung et al. [28] [†]	Swarmbug [27]	FSE	2021	D	Environment-Application (M) Format (M) No Publisher (M) Conflicting Publishers
Kortik and Shastha [36]	[37]	ICRA	2021	S/D	(N) Mismatches (M) No Publisher
Santos et al. [47] ^{†*}	HAROS [48]	ICSE-RoSE	2021	S/D	(T) Physical Units (TF) Incorrect Transform (TF) Missing Transform
Taylor et al. [51] [†]	SA4U [50]	ASE	2022	S	(DSL) URDF (P) Incorrect (Co) Sim vs Real (Co) Sensors (Co) Actuators (BUG) Infrastructure
Kim and Kim [34] [†]	RoboFuzz [33]	FSE	2022	D	(Co) Sensors (Ca) Camera
Das et al. [13]	-	ICRA	2022	D	(O) Simulation
Heiden et al. [25] [†]	[24]	ICRA	2022	D	(M) Conflicting Publishers (M) No Publisher (M) Format (N) Mismatches (N) Remapping (P) Dead Write (P) Incorrect
Timperley et al. [55] [†]	ROSDiscover [54]	ICSA	2022	S	(T) Constraints
Carvalho et al. [9] [†]	[8]	IROS	2020	D	(Co) Actuators (Co) Environment-Application (Co)
Wigand et al. [58] [†]	-	IROS	2020	S	Mechanical (Co) Environment-Application (Co) Mechanical (Co) Sim-vs-Real
DeVries et al. [14] [†]	Aether	ICSE-SEAMS	2022	S/D	

Identified 12 high-level categories of which 28 subcategories are not addressed by current techniques

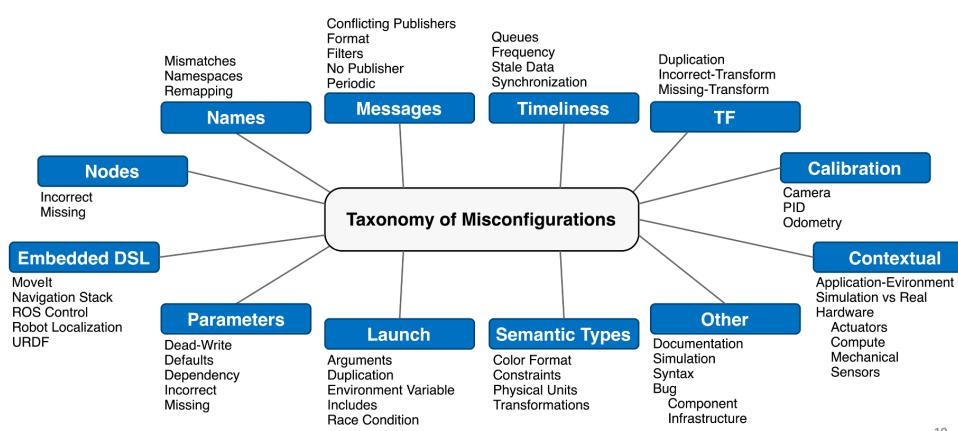


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Obtained a taxonomy of 12 high-level categories and 51 subcategories of misconfigurations



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Study the types of misconfigurations that developers make and to what extent analysis tools address them

RQ1. What kinds of misconfigurations do developers make when building robot software systems with ROS?

RQ2. To what extent do current techniques address these categories of misconfiguration?

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Obtained 17 relevant work where 23 subcategories of misconfigurations are addressed by current techniques

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Wigand et al. [58] [†]	-	IRROS	2020	S	(Co) Actuators (Co) Environment-Application (Co) Mechanical
DeVries et al. [14] [†]	Aether	ICSE-SEAMS	2022	S/D	(Co) Environment-Application (Co) Mechanical (Co) Sim-vs-Real

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