

Appendix: The Slow and The Furious?

Performance Antipattern Detection in Cyber-Physical Systems

Imara van Dinten^{a,*}, Pouria Derakhshanfar^b, Annibale Panichella^a, Andy Zaidman^a

^a*Delft University of Technology, Van Mourik Broekmanweg 6, 2628 XE, Delft, The Netherlands*

^b*JetBrains Research, Huidekoperstraat 26-28, 1017 ZM, Amsterdam, The Netherlands*

1. Introduction

This appendix consists of additional tables and information for Study I of the paper "The Slow and The Furious? Performance Antipattern Detection in Cyber-Physical Systems".

1.1. Appendix Structure

The appendix is structured as follows: Section 2 describes the keywords selected during the Initial Keyword Selection, Section 3 shows examples of the keywords selected during Keyword Expansion, Section 4 expands on the Commits selected and their relationship with the total number of Commits.

List of Tables

1	From the Initial Keyword Set: the number of occurrence of each keyword and instances a commit containing this keyword also contained a antipattern.	2
2	Example of Topic Modelling from the PX4-Autopilot project, highlighted are the words selected.	2
3	Resulting the Keyword Expansion, shown are the additional set of keywords per project. . . .	3
4	Expanded project information visualizing the commit results.	3

2. Initial Keyword Selection

This section relates to the paper's section 3.2.1 "Initial Keyword Selection".

From the Initial Keyword Set, the number of occurrences of each keyword is visualized in Table 1. Further, shown in this table is the number of instances a commit containing this keyword also contained an antipattern.

We decided to share this information in the appendix as this might be of interest as a motivation for future research towards a link between keywords and antipatterns.

3. Keyword Set Expansion with Information Retrieval and Topic Modeling

This section relates to the paper's section 3.2.2 "Keyword Set Expansion with Information Retrieval and Topic Modeling". As described in the paper, we applied Information Retrieval (IR) and Topic Modeling (TM) techniques to expand our set of keywords.

As an example, three topics from the PX4-Autopilot project are shown in Table 2. From these three topics, the words *size* and *rate* have been chosen. The full analysis of each project is publically available on GitHub ¹. The TM process resulted in a selection of keywords, for each project, as shown in Table 3.

*Corresponding author

Email addresses: I.vanDinten@tudelft.nl (Imara van Dinten, A.Panichella@tudelft.nl (Annibale Panichella)

¹ https://github.com/ciselab/CPS_repo_mining/tree/main/T-Model

Keyword	Occurrences		Antipatterns	
	Total	First	None	Detected
increase	481	398	115	283
memory	239	230	154	76
performance	101	98	58	40
faster	84	65	29	36
fast	74	57	39	18
slow	69	57	32	25
runtime	50	46	42	4
decrease	53	33	11	22
hang	144	19	17	2
infinite	17	15	11	4
overhead	28	14	8	6
slower	15	12	6	6
deadlock	10	9	3	6
speed	60	1	0	1
memory leak	36	1	1	0
increases	5	1	0	1
stuck	3	1	1	0
slowing	2	2	2	0
bottleneck	3	0	-	-
memory-heap	0	0	-	-
memory-leak	0	0	-	-
livelock	0	0	-	-
impasse	0	0	-	-
Total	1474	1059	529	530

Table 1: From the Initial Keyword Set: the number of occurrence of each keyword and instances a commit containing this keyword also contained a antipattern.

	Topic 1	Topic 2	Topic 3
1	param	stack	control
2	config	log	mode
3	default	size	attitude
4	romfs	reduce	fw
5	startup	logger	vtol
6	parameters	sdlog	controller
7	params	output	pos
8	board	logging	rate
9	configs	px	manual
10	script	buffer	land
11	start	usage	offboard
12	trigger	adjust	att
13	info	queue	transition
14	exclude	start	throttle
15	rsc	debug	tecs
16	meta	space	detector
17	airframe	verbose	parameter
18	scripts	dataman	estimator
19	vtol	priority	altitude
20	camera	ensure	wing

Table 2: Example of Topic Modelling from the PX4-Autopilot project, highlighted are the words selected.

4. Expanded table of commit results

This section relates to the paper’s section 3.4 ”Results”. As described in the paper, the PyRock tool returned a number of commits that potentially contain performance issues. Table 4 visualizes the total number of commits of each project ① with the number of selected commits (by PyRock) ②, false positives ③ and true positives ④, and the number of performance issues found ⑤. A single commit can contain more than one performance issue. Therefore, the number of performance issues found in a project can exceed the number of true positive commits.

Projects	Words (<i>Nr. of Antipatterns/Nr. of Commits</i>)
PX4-Autopilot	size (26/277), rate (50/355), speed (7/175), timeout (38/134), unneeded (1/62)
Andruino-esp32	corrected (1/4), optimize (0/7), wrong (0/18), size (0/30), timeout (3/15), timer (0/16), iot (0/11)
Grbl	cleaned (2/16), reflect (0/7), caused (0/2), changed (0/10), error (0/24), refactored (0/12), override (0/6), cleanup (0/8), tidying (0/2), optimization (0/7), disabling (0/4), size (0/10), edit (0/17), edits (0/6), speed (0/11), improved (0/9), rate (1/17), computation (0/2), clean (1/29), tweaks (0/5), optimized (1/5), corrected (0/6), realtime (0/2)
Dronekit Android	cleaned (0/24), broken (0/11), speed (2/26)
Node AR Drone	missing (0/4), errors (0/6), simplify (0/2), timeout (1/4), drop (0/4), explicit (0/2), expose (0/3), size (0/4), pave (0/5), wip (0/2), increased (1/2), broken (0/2), fixes (0/5), failing (0/2), check (0/4)
Android App Manager	improved (0/3), failure (0/2)
Cylon	halting (0/3), improve (0/17)
Johnny Five	clock (0/6), scaling (2/8), duration (0/5), improved (1/17), nitpicking (0/11), sensitivity (1/12), time (3/56), speed (3/20)
Robonomics-JS	-
Robonomics-Contracts	cleaning (0/2), expenses (0/3)
Vacuum Robot Mark II	unnecessary (0/2)
TurtleBot	convenient (0/2), cleanup (0/13), compatibility (0/4)
TurtleBot 3	compatibility (0/4), rate (9/10), inertia (1/4), frequency (4/4), size (2/2), limit (1/3)
Valetudo	time (1/35), timers (0/9), speed (0/14), timer (0/16), improve (0/19)

Table 3: Resulting the Keyword Expansion, shown are the additional set of keywords per project.

Project Name	① # of Commits	② Analysed Commits	③ False Positives	④ True Positives	⑤ # of Issues
PX4-Autopilot	35537	1869 (5.26%)	1297 (69.40%)	572 (30.60%)	653
Andruino-esp32	1747	140 (8.01%)	114 (81.43%)	26 (18.57%)	29
Grbl	699	217 (31.04%)	199 (91.71%)	18 (8.29%)	27
DroneKit Android	5810	99 (1.70%)	88 (88.89%)	11 (11.11%)	11
Node AR Drone	281	48 (17.08%)	47 (97.92%)	1 (2.08%)	2
Android App Manager	231	7 (3.03%)	6 (85.71%)	1 (14.29%)	2
Cylon	1323	21 (1.59%)	21 (100.00%)	0 (0.00%)	0
Johnny Five	3355	147 (4.38%)	131 (89.12%)	16 (10.88%)	14
Robonomics-JS	68	0 (0.00%)	0 (0.00%)	0 (0.00%)	0
Robonomics-Contracts	502	7 (1.39%)	7 (100.00%)	0 (0.00%)	0
Vacuum Robot Mark II	54	2 (3.70%)	2 (100.00%)	0 (0.00%)	0
TurtleBot	1142	24 (2.10%)	20 (83.33%)	4 (16.67%)	4
TurtleBot 3	526	27 (5.13%)	10 (37.04%)	17 (62.96%)	21
Valetudo	1043	91 (8.72%)	84 (92.31%)	7 (7.69%)	7
Total	52318	2699 (5.16%)	2026 (75.06%)	673 (24.94%)	770

Table 4: Expanded project information visualizing the commit results.