Optimizing the PDDL domain of TUSP to improve planner

Modifying the domain to improve planner execution time, plan quality, and problem sol

3. Domain Mod **1. Background** • TUSP: Train Unit Shunting Problem [1] • Initial domain (Figure 2) • Parking trains in shunting yards. Domain provided by supervisor. \circ Such that they can leave when needed (Figure 1). • PT domain (path-to-track) • PDDL: Planning Domain Definition Language [2] • Combined actions. swite • Problems as code. • Move from path to track in 1 step. total-• Initial state and goal state. MSR domain (minimize-switching-reallocation) • Action costs. • Find sequence of actions. • Minimize switching + reallocation. • Such that initial => goal. track • PT+MSR domain (Figure 3) • This research: • Combined actions + action costs. move-along-track • 4 planners from IPC 2018 move-on-arrival move-to-track swite track 2 move-from-track move-to-departure track switch occupied free

Figure 2: Initial domain actions. A train can move in five ways.

initial

150.50s

206.29s

0.01s

7.73s

Table 1: Planner total execution time of each planner per domain

initial

70

70

74

70

Table 2: Shortest plan length of each planner per domain

LAMA 2011

DecStar

Freelunch-Madagascar

Saarplan

LAMA 2011

DecStar

Freelunch-Madagascar

Saarplan

PT

0.20s

0.34s

0.06s

0.03s

PT

14

14

14

14

MSR

423.80s

591.46s

0.02s

40.84s

82

82

127

127

MSR | PT+MSR

4. Resul

PT+MSR

0.75s

1.27s

0.11s

0.12s

26

26

27

28

r <mark>performar</mark> vability	nce	Aut Shu s.ch	hor: -wing C niu-1@st	hiu udent.tudelft.nl	Supervisor: Issa Hanou i.k.hanou@tudelft.nl	Responsible Professor: Sebastijan Dumancic s.dumancic@tudelft.nl
h-to-next-train cost+1 move-on-ar total-cost+1	rival		 5. Discussion Execution time (Table 1) Decreases in PT. Increases in MSR. Plan quality (Table 2 & 3) PT decreases plan length + train switching for all planners. MSR decreases train switching for LAMA 2011 & DecStar. No differences in train reallocation. Problem solvability (Table 4) Number of plans make no difference. Correlation between execution time & number of plans. 			
move-to-departu total-cost+1 Figure 3: PT+MSR domain a	are ctions. A t	n to rain can	nove-from otal-cost-	m-track +1	 6. Cor PT domain shows tall domains. Faster executio LAMA 2011 shows all planners. Effectively minit 	clusion the best improvements of n time + less steps. the best improvement of mizes plan cost [3].
ts		1			7. Limitations	s & Future Work
	initial	PT	MSR	PT+MSR	Limited scope of or	omolete TUSP
LAMA 2011	38	12	12	12		n unit sizes
DecStar	48	12	12	12		i unit 31203.
Freelunch-Madagascar	56	12	57	13	 No tille stamps No different shi 	, Inting yard types
Saarplan	51	12	51	14		unung yaru types.
Table 3: Train switcl	nes in each	n plan p	• Techniques can be used in similar domains.			
	initial	PT	MSR	PT+MSR	• IUSP.	
LAMA 2011	1	1	10	5	• And other logis	tics domains.
DecStar	2	1	8	6		
Freelunch-Madagascar	1	1	1	1	[1] Richard Freling, Ramon M. Lentink, Leo G.	Kroon, and Dennis Huisman. Shunting of
Saarplan	2	1	3	1	passenger train units in a railway station. Trai [2] Maxence Grand, Humbert Fiorino, and Da	nsportation Science, 39(2):261-272, 2005. mien Pellier. Retro-engineering state machines
Table 4: Number of plans f	ound by e	ach pla	nner per do	omain	into PDDL domains. In IEEE International Cor pages 1186–1193, Baltimore (virtual conferen [3] Silvia Richter, Matthias Westphal, and Mal	nference on Tools with Artificial Intelligence, nce), United States, 2020. te Helmert. Lama 2008 and 2011. 2011.
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Freelunch-Madagascar	50	12	5/	15	 No different sh 	unting vard types
Saarpian	51	12	51	14	Techniques can be	e used in similar domains
Table 3: Train switch	ies in each	i pian p	 TUSP. 			
	initial	PT	MSR	PT+MSR	 And other logistics domains 	
LAMA 2011	1	1	10	5	And other togic	
DecStar	2	1	8	6		
Freelunch-Madagascar	1	1	1	1	[1] Richard Freling, Ramon M. Lentink, Leo G	Kroon, and Dennis Huisman. Shunting of
Saarplan	2	1	3	1	[2] Maxence Grand, Humbert Fiorino, and Da	misen Pellier. Retro-engineering state machines
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				and the second		

train arrivals train departures

Figure 1: Shunting yard example diagram. Trains 1, 2, and 3 are arriving at the shunting yard and need to be parked on either track 1 or track 2. This should be done in such a way that each train can depart with as little delay as possible when they need to.

2. Research Question

To what extent can we improve planner performance by optimizing the PDDL domain of TUSP?

Three sub-questions:

TUDelft

Planners

- 1. Is it possible to decrease the total execution time of planners?
- 2. Is it possible to increase the quality of the plan generated by planners?
- 3. Is it possible to increase problem solvability?

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Paper



