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1 CONTEXT
2   LeftTurnAssistCtx
3 EXTENDS
4   GenericCtx
5 CONSTANTS
6   waiting
7   turning
8   passed
9   Amax
10  Amin
11  B
12  k
13  q
14  Vmax
15  Tsv
16  Tpv
17  Tto0
18  Ttovmax
19  fsv1_decelerate
20  fsv1_accelerate
21  fsv1_accelerate_min
22  fsv1_stable
23  fsv2_speed
24  fpov_speed
25  f_decelerate
26  f_accelerate
27  f_accelerate_min
28  f_stable
29  ppov_init
30  vpov_init
31 AXIOMS
32  axm1: partition(STATES, {waiting}, {turning}, {passed})
33  axm2: Amax ∈ RRealPlusStar
34  axm3: Amin ∈ RRealPlusStar
35  axm32: Amin ↦ Amax ∈ It
36  axm4: B ∈ RRealPlusStar
37  axm5: k ∈ RRealPlusStar
38  axm6: q ∈ RRealPlusStar
39  axm7: Vmax ∈ RRealPlusStar
40  axm8:
41    Tsv = (λasv ↦ vsv ↦ psv · asv ∈ RReal ∧ Rzero ↦ asv ∈ It ∧ vsv ∈ RRealPlus ∧ psv ∈ RRealPlus ∧ psv ↦ q ∈ leq |
42      divide(plus(uminus(vsv) ↦ sqrt(plus(times(vsv) ↦ vsv) ↦ times(times(Rtwo ↦ asv) ↦ minus(q ↦ psv)))))) ↦ asv)
43    )
44  axm9: Tsv ∈ (RReal × RReal × RReal) ↦ RReal
45  axm10: Tpv = (λppv · ppov ∈ RReal | divide(minus(ppov ↦ k) ↦ Vmax))
46  axm11: Tpv ∈ RReal → RReal
47  axm12: Tto0 = (λa_ ↦ v0_ · a_ ∈ RReal ∧ a_ ↦ Rzero ∈ It ∧ v0_ ∈ RRealPlus | uminus(divide(v0_ ↦ a_)))
48  axm13:
49    Ttovmax = (λa_ ↦ v0_ · a_ ∈ RReal ∧ a_ ↦ Rzero ∈ gt ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax ∈ leq | divide(minus(Vmax ↦ v0_) ↦ a_))
50  axm14:
51    fsv1_decelerate = (λa_ ↦ v0_ · a_ ∈ RReal ∧ a_ ↦ Rzero ∈ It ∧ uminus(B) ↦ a_ ∈ leq ∧ v0_ ∈ RRealPlus |
52      untilF(Rzero, fcste(RReal × S, a_), Tto0(a_ ↦ v0_), fcste(RReal × S, Rzero))
53    )
54  axm15:
55    fsv1_accelerate = (λa_ ↦ v0_ · a_ ∈ RReal ∧ a_ ↦ Rzero ∈ gt ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax ∈ leq |
56      untilF(Rzero, fcste(RReal × S, a_), Ttovmax(a_ ↦ v0_), fcste(RReal × S, Rzero))
57    )
58  axm16:
59    fsv1_accelerate_min = (λa_ ↦ v0_ · a_ ∈ RReal ∧ a_ ↦ Amin ∈ gt ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax ∈ leq |
60      untilF(Rzero, fcste(RReal × S, a_), Ttovmax(a_ ↦ v0_), fcste(RReal × S, Rzero))
61    )
62  axm17: fsv1_stable = (λt_ ↦ eta_ · t_ ∈ RRealPlus ∧ eta_ ∈ S | Rzero)
63  axm18: fsv2_speed = (λt_ ↦ (vsv_ ↦ psv_ ↦ ppov_) · t_ ∈ RRealPlus ∧ (vsv_ ↦ psv_ ↦ ppov_) ∈ S | vsv_)
64  axm22:
65    fpov_speed = (λv_ · v_ ∈ RReal ∧ v_ ∈ Closed2Closed(uminus(Vmax), Rzero) |
66      fcste(RReal × S, v_)
67    )
68  axm23:
69    f_decelerate =
70    (λvpov_ ↦ a_ ↦ v0_ · vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Closed2Open(uminus(B), Rzero) ∧ v0_ ∈ RRealPlus |
71      bind(bind(fsv1_decelerate(a_ ↦ v0_), fsv2_speed), fpov_speed(vpov_))
72    )
73  axm24:

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73   f_accelerate =
74   (λvpov_ ↦ a_ ↦ v0_ · vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Open2Closed(Rzero, Amax) ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax
75
76     bind(bind(fsv1_accelerate(a_ ↦ v0_), fsv2_speed), fpov_speed(vpov_))
77   )
78   axm25 :
79   f_accelerate_min =
80   (λvpov_ ↦ a_ ↦ v0_ · vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Open2Closed(Amin, Amax) ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax
81
82     bind(bind(fsv1_accelerate_min(a_ ↦ v0_), fsv2_speed), fpov_speed(vpov_))
83   )
84   f_stable =
85   (λvpov_ · vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) |
86     bind(bind(fsv1_stable, fsv2_speed), fpov_speed(vpov_))
87   )
88   axm33 :
89   ∀vpov_, a_, v0_ ·
90     vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Closed2Open(uminus(B), Rzero) ∧ v0_ ∈ RRealPlus ⇒
91     partialPiecewiseContinuous(
92       {Closed2Open(Rzero, Tto0(a_ ↦ v0_)), Closed2Infinity(Tto0(a_ ↦ v0_))},
93       S, S,
94       f_decelerate(vpov_ ↦ a_ ↦ v0_)
95     )
96   axm34 :
97   ∀vpov_, a_, v0_ ·
98     vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Open2Closed(Rzero, Amax) ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax ∈ leq ⇒
99     partialPiecewiseContinuous(
100      {Closed2Open(Rzero, Ttovmax(a_ ↦ v0_)), Closed2Infinity(Ttovmax(a_ ↦ v0_))},
101      S, S,
102      f_accelerate(vpov_ ↦ a_ ↦ v0_)
103    )
104   axm35 :
105   ∀vpov_, a_, v0_ ·
106     vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ∧ a_ ∈ Closed2Closed(Amin, Amax) ∧ v0_ ∈ RRealPlus ∧ v0_ ↦ Vmax ∈ leq ⇒
107     partialPiecewiseContinuous(
108      {Closed2Open(Rzero, Ttovmax(a_ ↦ v0_)), Closed2Infinity(Ttovmax(a_ ↦ v0_))},
109      S, S,
110      f_accelerate_min(vpov_ ↦ a_ ↦ v0_)
111    )
112   axm36 :
113   ∀vpov_ ·
114     vpov_ ∈ Closed2Closed(uminus(Vmax), Rzero) ⇒
115     f_stable(vpov_) ∈ C0(RRealPlus × S, S)
116   axm37 : ppov_init ∈ RReal
117   axm38 : ppov_init ↦ k ∈ gt
118   axm39 : vpov_init ∈ Closed2Closed(uminus(Vmax), Rzero)

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END