

```

1 CONTEXT
2   AutobrakeCtx
3 EXTENDS
4   GenericCtx
5 CONSTANTS
6   stabilizing
7   accelerating
8   braking
9   nearing_stop
10  stopped
11  A
12  b
13  v0
14  SP
15  f2_speed
16  f1_deceleration
17  f1_stable
18  f1_acceleration
19  f_deceleration
20  f_stable
21  f_acceleration
22  eod
23  Vmax
24  x0
25 AXIOMS
26  axm1: partition(STATES, {stabilizing}, {accelerating}, {braking}, {nearing_stop}, {stopped})
27  axm2:  $A \in RReal$ 
28  axm3:  $Rzero \mapsto A \in lt$ 
29  axm4:  $b \in RReal$ 
30  axm5:  $Rzero \mapsto b \in lt$ 
31  axm51:  $b \neq Rzero$ 
32  axm6:  $v0 \in RReal$ 
33  axm7:  $Rzero \mapsto v0 \in lt$ 
34  axm62:  $x0 \in RReal$ 
35  axm72:  $Rzero \mapsto x0 \in lt$ 
36  axm8:  $SP \in RReal$ 
37  axm9:  $Rzero \mapsto SP \in lt$ 
38  axm010:  $Vmax \in RReal$ 
39  axm011:  $Rzero \mapsto Vmax \in lt$ 
40  axm154:  $f2\_speed \in (RRealPlus \times S) \rightarrow RReal$ 
41  axm155:  $f2\_speed = (\lambda t \mapsto (v \mapsto x) \cdot t \in RRealPlus \wedge (v \mapsto x) \in S \mid v\_)$ 
42  axm156:  $f1\_deceleration \in ((RRealPlus \times RRealPlus) \rightarrow (RRealPlus \times S \rightarrow RReal))$ 
43  axm11:
44     $\forall t\_init, v\_init \cdot t\_init \in RRealPlus \wedge v\_init \in RRealPlus \Rightarrow ($ 
45       $f1\_deceleration(t\_init \mapsto v\_init) =$ 
46         $(\lambda t \mapsto (v \mapsto x) \cdot t \in RRealPlus \wedge (v \mapsto x) \in S \wedge (t \mapsto plus(divide(v\_init \mapsto b) \mapsto t\_init) \in lt) \mid uminus(b)) \cup$ 
47         $(\lambda t \mapsto (v \mapsto x) \cdot t \in RRealPlus \wedge (v \mapsto x) \in S \wedge (t \mapsto plus(divide(v\_init \mapsto b) \mapsto t\_init) \in geq) \mid Rzero)$ 
48    )
49  axm10:  $f\_deceleration \in ((RRealPlus \times RRealPlus) \rightarrow (RRealPlus \times S \rightarrow S))$ 
50  axm102:  $\forall t\_init, v\_init \cdot t\_init \in RRealPlus \wedge v\_init \in RRealPlus \Rightarrow (f1\_deceleration(t\_init \mapsto v\_init) \in RRealPlus \times S \rightarrow RReal)$ 
51  axm101:
52     $\forall t\_init, v\_init \cdot t\_init \in RRealPlus \wedge v\_init \in RRealPlus \Rightarrow$ 
53       $f\_deceleration(t\_init \mapsto v\_init) = bind(f1\_deceleration(t\_init \mapsto v\_init), f2\_speed)$ 
54  axm12:  $f1\_stable \in (RRealPlus \times S \rightarrow RReal)$ 
55  axm13:  $f1\_stable = (\lambda t \mapsto (v \mapsto x) \cdot t \in RRealPlus \wedge (v \mapsto x) \in S \mid Rzero)$ 
56  axm130:  $f\_stable \in (RRealPlus \times S \rightarrow S)$ 
57  axm131:  $f\_stable = bind(f1\_stable, f2\_speed)$ 
58  axm132:  $f\_stable \in C0(RRealPlus \times S, S)$ 
59  axm14:  $f1\_acceleration \in (RRealPlus \times S \rightarrow RReal)$ 
60  axm15:  $f1\_acceleration = (\lambda t \mapsto (v \mapsto x) \cdot t \in RRealPlus \wedge (v \mapsto x) \in S \mid A)$ 
61  axm150:  $f\_acceleration \in (RRealPlus \times S \rightarrow S)$ 
62  axm151:  $f\_acceleration = bind(f1\_acceleration, f2\_speed)$ 
63  axm152:  $f\_acceleration \in C0(RRealPlus \times S, S)$ 
64  axm16:  $\forall t0 \cdot t0 \in RRealPlus \Rightarrow lipschitzContinuous(S, S, partial2(f\_stable, t0))$ 
65  axm17:  $\forall t0 \cdot t0 \in RRealPlus \Rightarrow lipschitzContinuous(S, S, partial2(f\_acceleration, t0))$ 
66  axm22:  $eod \in (RRealPlus \times RRealPlus \rightarrow RRealPlus)$ 
67  axm21:  $eod = (\lambda ti \mapsto vi \cdot ti \in RRealPlus \wedge vi \in RRealPlus \mid plus(divide(vi \mapsto b) \mapsto ti))$ 
68  axm20:
69     $\forall eta1, eta2, t\_init, v\_init, x\_init \cdot$ 
70       $t\_init \in RRealPlus \wedge v\_init \in RRealPlus \wedge x\_init \in RReal \wedge$ 
71       $eta1 \in Closed2Closed(t\_init, eod(t\_init \mapsto v\_init)) \rightarrow S \wedge$ 
72       $solutionOf($ 
73         $Closed2Closed(t\_init, eod(t\_init \mapsto v\_init)), eta1,$ 

```

```

74   ode(
75     ( $\lambda t\_ \mapsto (v\_ \mapsto x\_)$  ·  $t\_ \in RRealPlus \wedge (v\_ \mapsto x\_)$   $\in S \wedge (t\_ \mapsto eod(t\_init \mapsto v\_init)) \in lt$ ) | ( $uminus(b) \mapsto v\_$ )),
76     ( $v\_init \mapsto x\_init$ ),
77      $t\_init$ 
78   )
79 ) $\wedge$ 
80  $eta2 \in Closed2Infinity(eod(t\_init \mapsto v\_init)) \rightarrow S \wedge$ 
81  $solutionOf($ 
82    $Closed2Infinity(eod(t\_init \mapsto v\_init)), eta2,$ 
83   ode(
84     ( $\lambda t\_ \mapsto (v\_ \mapsto x\_)$  ·  $t\_ \in RRealPlus \wedge (v\_ \mapsto x\_)$   $\in S \wedge (t\_ \mapsto eod(t\_init \mapsto v\_init)) \in geq$ ) | ( $Rzero \mapsto v\_$ )),
85      $eta1(eod(t\_init \mapsto v\_init)),$ 
86      $eod(t\_init \mapsto v\_init)$ 
87   )
88 ) $\Rightarrow$ 
89  $solutionOf($ 
90    $Closed2Infinity(t\_init), eta1 \cup eta2,$ 
91   ode(
92      $f\_deceleration(t\_init \mapsto v\_init),$ 
93     ( $v\_init \mapsto x\_init$ ),
94      $t\_init$ 
95   )
96 )
97 axm153 :
98  $\forall t\_init, v\_init, x\_init.$ 
99  $t\_init \in RRealPlus \wedge v\_init \in RRealPlus \wedge x\_init \in RReal \Rightarrow$ 
100  $Solvable($ 
101    $Closed2Infinity(t\_init),$ 
102   ode(
103      $f\_deceleration(t\_init \mapsto v\_init),$ 
104     ( $v\_init \mapsto x\_init$ ),
105      $t\_init$ 
106   )
107 )
108 END

```