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CONTEXT
    AutobrakeCtx
EXTENDS
    GenericCtx
CONSTANTS
    stabilizing
    accelerating
    braking
    nearing_stop
    stopped
    A
    b
    v0
    SP
    f2_speed
    f1_deceleration
    f1_stable
    f1_acceleration
    f_deceleration
    f_stable
    f_acceleration
    eod
    Vmax
    x0
AXIOMS
    axm1 :  partition(STATES, {stabilizing}, {accelerating}, {braking}, {nearing_stop}, {stopped})
    axm2 :  A ∈ RReal
    axm3 :  Rzero ↦ A ∈ lt
    axm4 :  b ∈ RReal
    axm5 :  Rzero ↦ b ∈ lt
    axm51 :  b ≠ Rzero
    axm6 :  v0 ∈ RReal
    axm7 :  Rzero ↦ v0 ∈ lt
    axm62 :  x0 ∈ RReal
    axm72 :  Rzero ↦ x0 ∈ lt
    axm8 :  SP ∈ RReal
    axm9 :  Rzero ↦ SP ∈ lt
    axm010 :  Vmax ∈ RReal
    axm011 :  Rzero ↦ Vmax ∈ lt
    axm154 :  f2_speed ∈ (RRealPlus × S) → RReal
    axm155 :  f2_speed = (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S | v_)
    axm156 :  f1_deceleration ∈ ((RRealPlus × RRealPlus) → (RRealPlus × S → RReal))
    axm11 :
        ∀t_init, v_init · t_init ∈ RRealPlus ∧ v_init ∈ RRealPlus ⇒ (
            f1_deceleration(t_init ↦ v_init) =
                (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S ∧ (t_ ↦ plus(divide(v_init ↦ b) ↦ t_init) ∈ lt) | uminus(b))∪
                (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S ∧ (t_ ↦ plus(divide(v_init ↦ b) ↦ t_init) ∈ geq) | Rzero)
        )
    axm10 :  f_deceleration ∈ ((RRealPlus × RRealPlus) → (RRealPlus × S → S))
    axm102 :  ∀t_init, v_init · t_init ∈ RRealPlus ∧ v_init ∈ RRealPlus ⇒ (f1_deceleration(t_init ↦ v_init) ∈ RRealPlus × S → RReal)
    axm101 :
        ∀t_init, v_init · t_init ∈ RRealPlus ∧ v_init ∈ RRealPlus ⇒
            f_deceleration(t_init ↦ v_init) = bind(f1_deceleration(t_init ↦ v_init), f2_speed)
    axm12 :  f1_stable ∈ (RRealPlus × S → RReal)
    axm13 :  f1_stable = (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S | Rzero)
    axm130 :  f_stable ∈ (RRealPlus × S → S)
    axm131 :  f_stable = bind(f1_stable, f2_speed)
    axm132 :  f_stable ∈ C0(RRealPlus × S, S)
    axm14 :  f1_acceleration ∈ (RRealPlus × S → RReal)
    axm15 :  f1_acceleration = (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S | A)
    axm150 :  f_acceleration ∈ (RRealPlus × S → S)
    axm151 :  f_acceleration = bind(f1_acceleration, f2_speed)
    axm152 :  f_acceleration ∈ C0(RRealPlus × S, S)
    axm16 :  ∀t0 · t0 ∈ RRealPlus ⇒ lipschitzContinuous(S, S, partial2(f_stable, t0))
    axm17 :  ∀t0 · t0 ∈ RRealPlus ⇒ lipschitzContinuous(S, S, partial2(f_acceleration, t0))
    axm22 :  eod ∈ (RRealPlus × RRealPlus → RRealPlus)
    axm21 :  eod = (λti ↦ vi · ti ∈ RRealPlus ∧ vi ∈ RRealPlus | plus(divide(vi ↦ b) ↦ ti))
    axm20 :
        ∀eta1, eta2, t_init, v_init, x_init·
                t_init ∈ RRealPlus ∧ v_init ∈ RRealPlus ∧ x_init ∈ RReal∧
            eta1 ∈ Closed2Closed(t_init, eod(t_init ↦ v_init)) → S∧
            solutionOf(
                Closed2Closed(t_init, eod(t_init ↦ v_init)), eta1,
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            ode(
                (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S ∧ (t_ ↦ eod(t_init ↦ v_init) ∈ lt) | (uminus(b) ↦ v_)),
                (v_init ↦ x_init),
                t_init
            )
        )∧
        eta2 ∈ Closed2Infinity(eod(t_init ↦ v_init)) → S∧
        solutionOf(
            Closed2Infinity(eod(t_init ↦ v_init)), eta2,
            ode(
                (λt_ ↦ (v_ ↦ x_) · t_ ∈ RRealPlus ∧ (v_ ↦ x_) ∈ S ∧ (t_ ↦ eod(t_init ↦ v_init) ∈ geq) | (Rzero ↦ v_)),
                eta1(eod(t_init ↦ v_init)),
                eod(t_init ↦ v_init)
            )
        ) ⇒
            solutionOf(
                Closed2Infinity(t_init), eta1 ∪ eta2,
                            ode(
                        f_deceleration(t_init ↦ v_init),
                        (v_init ↦ x_init),
                        t_init
                    )
                    )
  axm153 :
    ∀t_init, v_init, x_init·
        t_init ∈ RRealPlus ∧ v_init ∈ RRealPlus ∧ x_init ∈ RReal ⇒
            Solvable(
                Closed2Infinity(t_init),
                ode(
                    f_deceleration(t_init ↦ v_init),
                    (v_init ↦ x_init),
                    t_init
                )
            )
END
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