Flat Missile VDM-SL example

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types

   1.0 $MissileInputs = MissileInput^*$;

   2.0 $MissileInput = MissileType \times Angle$;

   3.0 $MissileType = $ MISSILEA | MISSILEB | MISSILEC | NONE;

   4.0 $Angle = \mathbb{N}$

    .1   inv $num \triangleq num \leq 360$;

   5.0 $Output = MagId \xrightarrow{m} OutputStep^*$;

   6.0 $MagId = $ token;

   7.0 $OutputStep = FlareType \times AbsTime$;

   8.0 $Response = FlareType \times \mathbb{N}$;

   9.0 $AbsTime = \mathbb{N}$;

 10.0 $FlareType = $ FLAREONEA | FLARETWOA | FLAREONEB |
    .1   FLARETWOB | FLAREONEC | FLARETWOC |
    .2   DONOTHINGA | DONOTHINGB | DONOTHINGC;

 11.0 $Plan = (FlareType \times Delay)^*$;

 12.0 $Delay = \mathbb{N}$

values

13.0 $responseDB : MissileType \xrightarrow{m} Plan = \{$MISSILEA $\mapsto$ [mk- (FLAREONEA, 900), mk- (FLARE
.1   mk- (DONOTHINGA, 100), mk- (FLAREONEA, 500)
.2   MISSILEB $\mapsto$ [mk- (FLARETWOB, 500), mk- (FLARE
.3   MISSILEC $\mapsto$ [mk- (FLAREONEC, 400), mk- (DONO
.4   mk- (FLARETWOC, 400), mk- (FLAREONEC, 500)]]

14.0 $missilePriority : MissileType \xrightarrow{m} \mathbb{N} = \{$MISSILEA $\mapsto 1,$
.1   MISSILEB $\mapsto 2,$
.2   MISSILEC $\mapsto 3,$
.3   NONE $\mapsto 0\};$

15.0 $stepLength : \mathbb{N} = 100;$

16.0 $testval1 : MissileInputs = $ [mk- (MISSILEA, 88),
.1   mk- (MISSILEB, 70),
.2   mk- (MISSILEA, 222),
.3   mk- (MISSILEC, 44)];

17.0 $testval2 : MissileInputs = $ [mk- (MISSILEC, 188),
.1   mk- (MISSILEB, 70),
.2   mk- (MISSILEA, 2),
.3   mk- (MISSILEC, 44)];

18.0 $testval3 : MissileInputs = $ [mk- (MISSILEA, 288),
.1   mk- (MISSILEB, 170),
.2   mk- (MISSILEA, 222),
.3   mk- (MISSILEC, 44)]

functions

19.0 $CounterMeasures : MissileInputs \rightarrow Output$

.1 $CounterMeasures\,(missileInputs) \triangleq$
.2 $CM\,(missileInputs, \{\mapsto\}, \{\mapsto\}, 0);$

20.0 $CM : MissileInputs \times Output \times MagId \xrightarrow{m} [MissileType] \times \mathbb{N} \rightarrow$
.1 $Output$

.2 $CM\,(missileInputs, outputSoFar, lastMissile, curTime) \triangleq$
.3   if $missileInputs = []$
.4   then $outputSoFar$
.5   else let mk-$(curMis, angle) =$ hd $missileInputs,$
.6 $magid = Angle2MagId\,(angle)$ in
.7   if $magid \notin$ dom $lastMissile \vee$
.8 $(magid \in$ dom $lastMissile \wedge$
.9 $missilePriority\,(curMis) >$
.10 $missilePriority\,(lastMissile\,(magid)))$
.11   then let $newOutput =$
.12 $InterruptPlan\,(curTime, outputSoFar,$
.13 $responseDB\,(curMis),$
.14 $magid)$ in
.15 $CM\,($tl $missileInputs, newOutput,$
.16 $lastMissile \dagger \{magid \mapsto curMis\},$
.17 $curTime + stepLength)$
.18   else $CM\,($tl $missileInputs, outputSoFar,$
.19 $lastMissile, curTime + stepLength);$

21.0 $InterruptPlan : \mathbb{N} \times Output \times Plan \times MagId \rightarrow Output$

.1 $InterruptPlan\,(curTime, expOutput, plan, magid) \triangleq$
.2 $\{magid \mapsto$
.3   (if $magid \in$ dom $expOutput$
.4   then $LeavePrefixUnchanged\,(expOutput\,(magid),$
.5 $curTime)$
.6   else $[]) \curvearrowright$
.7 $MakeOutputFromPlan\,(curTime, plan)\} \uplus$
.8 $(\{magid\} \triangleleft expOutput);$

22.0 $LeavePrefixUnchanged : OutputStep^* \times \mathbb{N} \rightarrow$
.1 $\qquad\qquad\qquad OutputStep^*$

.2 $LeavePrefixUnchanged\,(output\text{-}l, curTime) \triangleq$
.3 $\quad [output\text{-}l\,(i) \mid i \in \mathsf{inds}\ output\text{-}l \cdot$
.4 $\qquad\quad \mathsf{let\ mk\text{-}}(\text{-}, t) = output\text{-}l\,(i)\ \mathsf{in}$
.5 $\qquad\quad t \leq curTime];$

23.0 $MakeOutputFromPlan : \mathbb{N} \times Response^* \rightarrow OutputStep^*$

.1 $MakeOutputFromPlan\,(curTime, response) \triangleq$
.2 $\quad \mathsf{let}\ output = OutputAtTimeZero\,(response)\ \mathsf{in}$
.3 $\quad [\mathsf{let\ mk\text{-}}(flare, t) = output\,(i)\ \mathsf{in}$
.4 $\quad\ \mathsf{mk\text{-}}(flare, t + curTime) \mid$
.5 $\qquad\quad i \in \mathsf{inds}\ output];$

24.0 $OutputAtTimeZero : Response^* \rightarrow OutputStep^*$

.1 $OutputAtTimeZero\,(response) \triangleq$
.2 $\quad \mathsf{let}\ absTimes = RelativeToAbsoluteTimes\,(response)\ \mathsf{in}$
.3 $\quad \mathsf{let\ mk\text{-}}(firstFlare, \text{-}) = \mathsf{hd}\ absTimes\ \mathsf{in}$
.4 $\quad [\mathsf{mk\text{-}}(firstFlare, 0)] \curvearrowright$
.5 $\quad [\mathsf{let\ mk\text{-}}(\text{-}, t) = absTimes\,(i - 1),$
.6 $\qquad\quad \mathsf{mk\text{-}}(f, \text{-}) = absTimes\,(i)\ \mathsf{in}$
.7 $\quad\ \mathsf{mk\text{-}}(f, t) \mid$
.8 $\qquad\quad i \in \{2, \ldots, \mathsf{len}\ absTimes\}];$

25.0 $RelativeToAbsoluteTimes : Response^* \rightarrow$
.1 $\qquad\qquad\qquad (FlareType \times \mathbb{N})^*$

.2 $RelativeToAbsoluteTimes\,(ts) \triangleq$
.3 $\quad \mathsf{if}\ ts = []$
.4 $\quad \mathsf{then}\ []$
.5 $\quad \mathsf{else\ let\ mk\text{-}}(f, t) = \mathsf{hd}\ ts,$
.6 $\qquad\quad ns = RelativeToAbsoluteTimes\,(\mathsf{tl}\ ts)\ \mathsf{in}$
.7 $\qquad [\mathsf{mk\text{-}}(f, t)] \curvearrowright [\mathsf{let\ mk\text{-}}(nf, nt) = ns\,(i)\ \mathsf{in}$
.8 $\qquad\ \mathsf{mk\text{-}}(nf, nt + t) \mid$
.9 $\qquad\qquad i \in \mathsf{inds}\ ns];$

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26.0 $Angle2MagId : Angle \rightarrow MagId$

.1 $Angle2MagId\,(angle) \triangleq$
.2   if $angle < 90$
.3   then mk-token $("Magazine\ 1")$
.4   elseif $angle < 180$
.5   then mk-token $("Magazine\ 2")$
.6   elseif $angle < 270$
.7   then mk-token $("Magazine\ 3")$
.8   else mk-token $("Magazine\ 4")$

Test Suite :   vdm.tc
Module :   DefaultMod

Name	#Calls	Coverage
CM	45	√
Angle2MagId	36	√
InterruptPlan	33	√
CounterMeasures	9	√
OutputAtTimeZero	33	√
MakeOutputFromPlan	33	√
LeavePrefixUnchanged	9	√
RelativeToAbsoluteTimes	147	√
Total Coverage		**100%**

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