Homework Assignment 4

To: CSci 5802, All students
CC: Teaching Assistant
From: Dr. Mats Heimdahl
Date: 11/2/2006
Re: Homework Assignment 4

The Problem
The altimeters are finally available and we need to extend our model to accommodate this new information. This is task one in this assignment.

More instructions are available below.

The Language
Since the customer knows we have vast experience with the formalism provided through RSML-e and its execution environment, they want us to continue to use the RSML-e notation. Also, they feel that since we worked so hard to understand their slightly flawed environment model expressed as an Excel spreadsheet, they will let you use that one for the simulation of the new system.

The Changes
We now have three altimeters providing us altitude—two digital radio altimeters and one analog barometric altimeter.

The digital altimeters provide altitude in the manner you are used to. They provide an integer altitude and an indication if the altitude it trustworthy.

The analog altimeter works differently. It will indicate if you are above or below the thresholds, it will not give you an actual altitude. It will send you True if you are below the threshold and False if you are above the threshold. Since the analog altimeter does not have a concept of hysteresis, it can only be used in the decisions to turn the DOI on, not in the decisions to turn the DOI off.

To make the system robust and safe (it is considered unsafe if we do not turn on the DOI when we should), we will use the redundant altimeters for fault tolerance.

- We will consider the ASW to be below the threshold if any of the altimeters indicating they are still providing trustworthy altitude reports that we are below the threshold.
- We will consider ourselves to be above the threshold plus hysteresis if all of the still functioning digital altimeters indicate we are above.
• We will consider ourselves to have untrustworthy altitude data if any two altimeters are indicating their altitude reports are not valid.

The Interfaces with the Environment
The new interfaces with the altimeters are provided last in this handout as well as on the web. You will need to replace the AltitudeMessageInterface with the new interface. You will also have to replace the input variables Altitude and AltitudeQuality with the six new variables shown below.

You will now have to modify your model to use these three altitude measures and three altitude qualities to make decisions about whether you are above or below the thresholds. The decision procedure for this was provided above.

Running Simulations
An RSML\textsuperscript{e} model of the altimeters is available on the web (with an nscript file to connect its channels). This RSML\textsuperscript{e} model will run between the Excel spreadsheet and the ASW. This model simulates the three altimeters and takes the altitude reported from Excel and splits it to the three altitude reports discussed above.

![Diagram of Altitude Channels](attachment:altimeter_channels.png)

Your ASW model will now have to connect all channels except the AltitudeChannel to the Excel spreadsheet. The Altitude channel has been renamed and should now be connected to the Altimeter RSML\textsuperscript{e} model. A script performing this is also on the web page. Just change the name of the script to the name of your ASW model to have it loaded automatically. Running things in this setup will provide you with three altitudes to the ASW so you can implement the changes.

Simulating Failures
Altimeters may fail. To simulate this, the AltitudeBad button in the Excel Simulation is used. If you press this button, you will fail a selection of the altimeters in the altimeter RSML\textsuperscript{e} model. You can determine which altimeters to fail by changing the value of the FailAlt1, FailAlt2, and FailAlt3 constants in the model. If the constant is set to True, the corresponding altimeter will fail when you press the AltitudeBad button (altimeter 3 is the analog altimeter). The model on the web fails altimeter 1 and 3 by default.

ASW Model selection
If you are not happy with your own ASW model, you can use the one I provided on the web with no penalty.

Interaction with the Customer
Questions regarding the behavior of the ASW, problems with Nimbus, etc. (you know the drill) shall be posted on the Phorum.

Technical Support
Questions regarding RSML\textsuperscript{e} and Nimbus shall be posted on the Forum.
Information and sample files will also be posted on the web pages—please check them regularly.

**Useful Reading**
Available on the web.


**Your Task**
Modify your RSML\textsuperscript{+} model of the ASW to accommodate the new hardware and fault tolerance mechanisms.

**Deliverables**
I expect you to make sure the specification is (1) liberally commented, (2) syntactically correct and type checked (done when parsed into Nimbus), and (3) tested with some test suites. Hand in the following:

1. A soft copy of the specification.

**Due Date**
The deliverables must be presented to the customer (Mats Heimdahl) no later than in class on Thursday, November 9.
Interfaces to the Environment
The following code is available on the web and you can simply paste it in instead of the Altitude interface you have now.

Communication with the altimeters

TYPE_DEF AltitudeQualityType { Good, Bad }

MESSAGE AltInMessage {
    a1 IS INTEGER,
    alt1q IS AltitudeQualityType,
    a2 IS INTEGER,
    alt2q IS AltitudeQualityType,
    a3 IS BOOLEAN,
    alt3q IS AltitudeQualityType
}

/****************************************************************************
The interface to the three altimeters
****************************************************************************/
IN_INTERFACE AltitudeInInterface :
    MIN_SEP : UNDEFINED
    MAX_SEP : UNDEFINED
    INPUT_ACTION : RECEIVE(AltInMessage)

HANDLER :
    CONDITION : TRUE

    ASSIGNMENT
        Altitude1 := a1,
        AltitudeQ1 := alt1q,
        Altitude2 := a2,
        AltitudeQ2 := alt2q,
        AltitudeBelow3 := a3,
        AltitudeBelowQ3 := alt3q
    END ASSIGNMENT
END HANDLER
END IN_INTERFACE
The input variables for the three altimeters (6 total)

IN_VARIABLE Altitude1 : INTEGER
    INITIAL.VALUE : Undefined
    UNITS : ft
    EXPECTED_MIN : 0
    EXPECTED_MAX : 40000
END IN_VARIABLE

IN_VARIABLE AltitudeQ1 : AltitudeQualityType
    INITIAL.VALUE : Undefined
END IN_VARIABLE

IN_VARIABLE Altitude2 : INTEGER
    INITIAL.VALUE : Undefined
    UNITS : ft
    EXPECTED_MIN : 0
    EXPECTED_MAX : 40000
END IN_VARIABLE

IN_VARIABLE AltitudeQ2 : AltitudeQualityType
    INITIAL.VALUE : Undefined
END IN_VARIABLE

IN_VARIABLE AltitudeBelow3 : Boolean
    INITIAL.VALUE : Undefined
END IN_VARIABLE

IN_VARIABLE AltitudeBelowQ3 : AltitudeQualityType
    INITIAL.VALUE : Undefined
END IN_VARIABLE