PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1   **Academic Year**: 2006-2007

Date: 6 July 2006   **Time**: 13.30-16.30 (3 hours)

Subject Number: 240-631   **Room**: Robot Head

Subject Title: Parallel and Distributed Simulation Systems

Exam Duration: 3 hours

This paper has 11 pages, 7 questions and 90 marks (30%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, handouts, and dictionaries are permitted.

Instructions to Students:

- Scan all the questions before answering so that you can manage your time better.
- Attempt all questions in <u>Thai</u>.
- Write your name and ID on every page.
- Any unreadable parts will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments; marks will not be deducted for minor syntax errors.

ทุจริตในการสอบ

โทษขั้นต่ำ   ปรับตกในรายวิชานั้นและพักการเรียน 1 ภาคการศึกษา

โทษสูงสุด   ให้ออก

Question 1 (37 marks; 80 minutes)

a) What is a simulation? (2 marks)

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b) What are the differences between _event-driven simulation_ and _time-driven simulation_ frameworks? (2 marks)

Event-driven	Time-driven

c) What is parallel or distributed simulation and what are the benefits? (3 marks)

Parallel Simulation	Distributed Simulation

d) What are the differences between _virtual environments_ and _analytic simulations_? (4 marks)

Virtual Environments	Analytic Simulations

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e) What are the differences between *parallel computers* and *distributed computers*? (4 marks)

Parallel Computers	Distributed Computers

f) Tell how multiprocessors share memory. (1 marks)

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g) What are the differences amongst *simulation time, physical time* and *wallclock time*? (3 marks)

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h) What are the differences between *real-time* and *as-fast-as-possible* modes of execution? (2 marks)

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i) What are the differences between *simulation executive* and *simulation application*?   (2 marks)

Simulation executive	Simulation Application

j) Compare *broadcast* and *publish-and-subscribe* mechanism of message passing.   (4 marks)

Broadcast mechanism	Publish-and-subscribe mechanism

k) Explain the *callback* function.   (2 marks)

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l) What are the differences between *dynamic* and *static* data distribution?

(2 marks)

Dynamic Data Distribution	Static Data Distribution

m) Why does the dynamic data distribution prefer *region* to *point*?

(2 marks)

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n) What are the differences between *push/pull* and *centralized/distributed* clock synchronization algorithms? (4 marks)

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Question 2 (12 marks; 15 minutes)

a) Suppose that we would like the simulation to run slower in synchrony with an equivalent advance in wallclock time. What are the required scaling factor and the transfer equation of the simulation time and wallclock time? (4 marks)

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b) Complete the connection between the RTI and the following federate program.

(4 marks)

federated simulator	*RTI*

While (simulation not complete)
　　T = time of next event in PES
　　PendingNER = TRUE;
　　NextEventRequest(T)
　　while (PendingNER) Tick();
　　process next event in PES
End-While
 	
/* the following federate-ambassador procedures are called by the RTI
　　*/
Procedure ReflectAttributeValues (...)
　　place event in PES
 	
Procedure TimeAdvanceGrant (...)
　　PendingNER = False;	

c) Complete the connection between the RTI and the following federate program.

(4 marks)

<table>
<tr><td>

federated simulator
While (simulation not complete)
    update local simulation state
    UpdateAttributeValues (...)
    PendingTAR = TRUE;
    TimeAdvanceRequest(T+ ΔT)
    while (PendingTAR) Tick(...);
    T = T + ΔT;
End-While
/ the following federate-defined procedures are called by the RTI */*
    Procedure ReflectAttributeValues (...)
    update local state
    Procedure TimeAdvanceGrant (...)
    PendingTAR = False;

</td><td>

RTI

</td></tr>
</table>

Question 3   (10 marks; 20 minutes)

From the following process program, show the relationship between state variables and time when R = 2 and G = 3, and airplanes F1 and F2 are scheduled to arrive at 1 time unit and 3 time units consecutively. Also demonstrate the process change in the event pending list.

/* simulate aircraft arrival, circling, and landing */

Integer: InTheAir;

Integer: OnTheGround;

Boolean: RunwayFree;

1   InTheAir := InTheAir + 1;

2   WaitUntil (RunwayFree);   /* circle */

3   RunwayFree := FALSE;   /* land */

4   AdvanceTime(R);

5   RunwayFree := TRUE;

/* simulate aircraft on the ground */
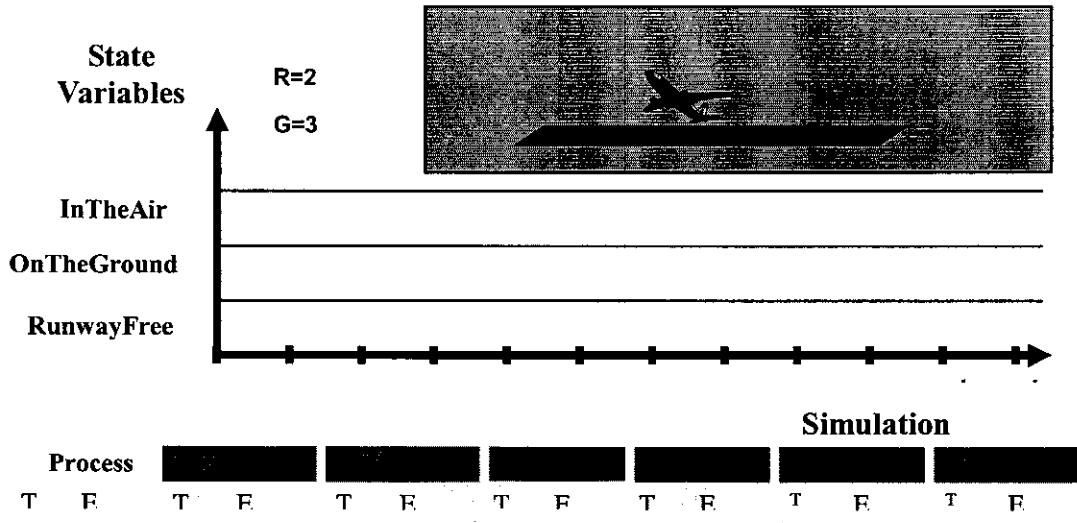
6   InTheAir := InTheAir - 1;

7   OnTheGround := OnTheGround + 1;
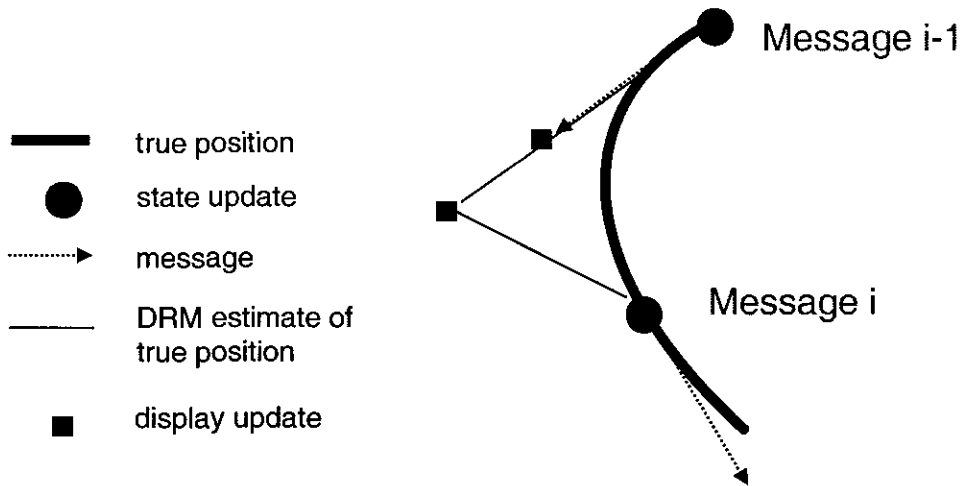
8   AdvanceTime(G);

/* simulate aircraft departure */

9   OnTheGround := OnTheGround - 1;

State Variables

R=2

G=3

InTheAir

OnTheGround

RunwayFree

Simulation

Process

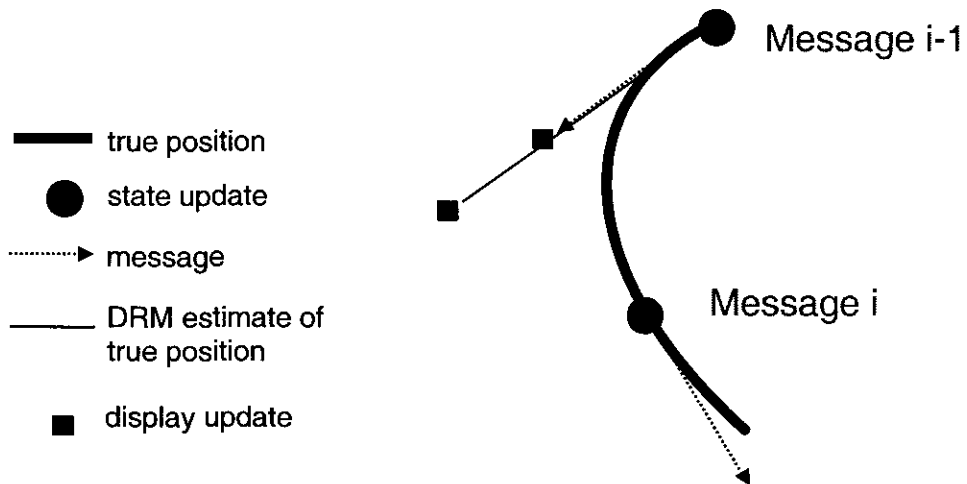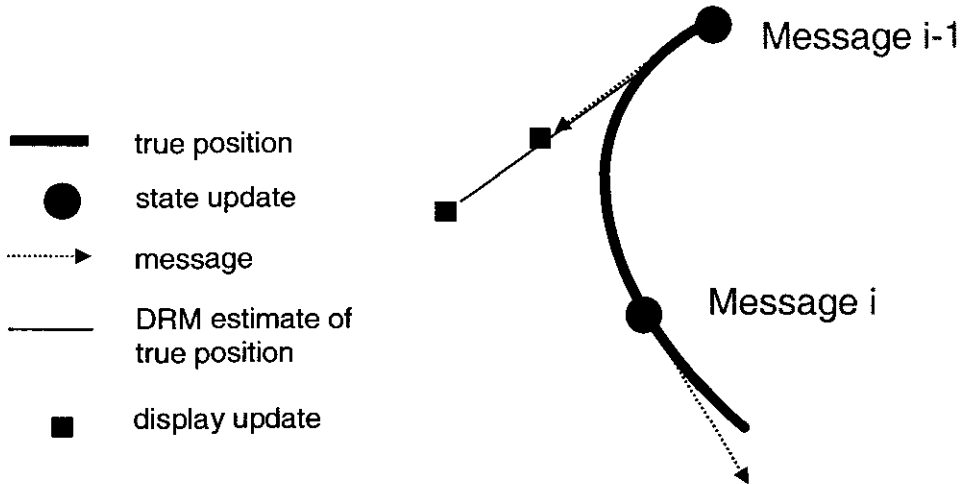| T	F	T	F	T	F	T	F	T	F	T	F	T	F

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Question 4 (10 marks; 20 minutes)

From the following disjointed graph below, show how *time compensation* and *smoothing* algorithms change the display.

true position
state update
message
DRM estimate of true position
display update

Message i-1

Message i

a) Time Compensation   (1 mark)

true position
state update
message
DRM estimate of true position
display update

Message i-1

Message i

b) Smoothing

Legend:
- **true position** (thick line)
- **state update** (large filled circle)
- **message** (dotted arrow)
- **DRM estimate of true position** (thin line)
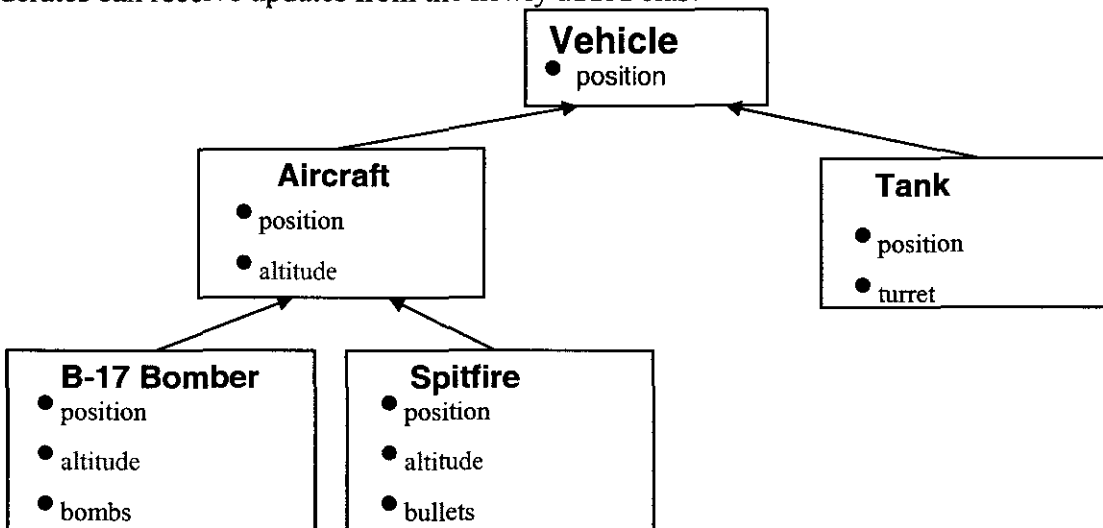- **display update** (small filled square)

Question 5 (5 marks; 10 minutes)

From this diagram, add class *Ship* into the diagram and explain how the other federates can receive updates from the newly added class.


```
Vehicle
 • position

Aircraft                        Tank
 • position                      • position
 • altitude                      • turret

B-17 Bomber        Spitfire
 • position         • position
 • altitude         • altitude
 • bombs            • bullets
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Question 6   (10 marks; 10 minutes)

From the following picture, show *duplicate* and *unwanted* updates at Sensor 1 and Sensor 2.

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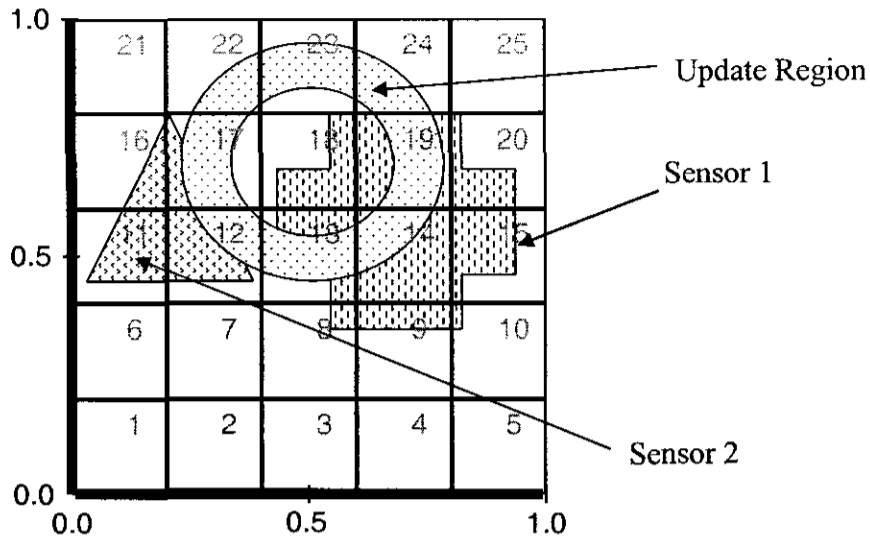
Question 7   (6 marks; 15 minutes)

a) According to the Network Time Protocol Latency and Offset Estimation, explain the four time stamps stored in message: T1, T2, T3, T4.   (4 marks)

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b) Suppose clock is 13 milliseconds ahead, interrupt generated every 10 milliseconds, show how to phase in clock change when correct or re-synchronizing clocks.

(2 marks)

----End of Examination----

Pichaya Tandayya

Lecturer