The world of information fusion

Definition

Information Fusion, in the context of its use by the (Information Fusion) Society, encompasses the **theory**, **techniques** and **tools** conceived and employed

The world of information fusion

Definition

Information Fusion, in the context of its use by the (Information Fusion) Society, encompasses the **theory**, **techniques** and **tools** conceived and employed **for exploiting the synergy in the information acquired from multiple sources** (sensor, databases, information gathered by humans, etc.)

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

The world of information fusion

Definition

Information Fusion, in the context of its use by the (Information Fusion) Society, encompasses the **theory**, **techniques** and **tools** conceived and employed **for exploiting the synergy in the information acquired from multiple sources** (sensor, databases, information gathered by humans, etc.) such that the **resulting decision or action is in some sense better** than (qualitatively or quantitatively, in terms of accuracy, robustness and etc.) than would be possible if any of these sources were used individually without such synergy exploitation.

/Belur Dasarathy

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Background in C2

The information fusion field owes a heavy heritage to the research in *command and control* (C^2) *systems* in (american) military industry.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Background in C2

The information fusion field owes a heavy heritage to the research in *command and control (C^2) systems* in (american) military industry.

Command and control systems

Are the management infrastructure for defence and war or for any other large-scale complex dynamic information/resource management system.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Background in C2

The information fusion field owes a heavy heritage to the research in *command and control (C^2) systems* in (american) military industry.

Command and control systems

Are the management infrastructure for defence and war or for any other large-scale complex dynamic information/resource management system.

Nowadays, the representatives of IF want to be less dependent on works in command and control and combat aviation.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Motivations for DF/IF

Motivations when using homogeneous or heterogeneous sensors

Robustness - one sensor can report when other cannot

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Motivations for DF/IF

Motivations when using homogeneous or heterogeneous sensors

Robustness - one sensor can report when other cannot

Extended covarage - in time and space

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Motivations for DF/IF

Motivations when using homogeneous or heterogeneous sensors

Robustness - one sensor can report when other cannot

Extended covarage - in time and space

Increased confidence - several sensors can confirm the same measurement

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Motivations for DF/IF

Motivations when using homogeneous or heterogeneous sensors

Robustness - one sensor can report when other cannot

Extended covarage - in time and space

Increased confidence - several sensors can confirm the same measurement

Improved system reliability - redundant measurements

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Motivations for DF/IF

Motivations when using homogeneous or heterogeneous sensors

Robustness - one sensor can report when other cannot

Extended covarage - in time and space

Increased confidence - several sensors can confirm the same measurement

Improved system reliability - redundant measurements

Complementary information - sensors measuring different kinds of properties

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

ISIF

International society of information fusion 

`http://www.inforfusion.org/`

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

Mission of ISIF

- Advocate
- Serve
- Communicate
- Educate
- Integrate
- Disseminate

Scientific exchange

- Information fusion conference

FOI
SWEDISH DEFENCE
RESEARCH AGENCY

Centre for Autonomous Systems

Scientific exchange

- Information fusion conference

- Journal of informaton fusion, Elsevier

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Scientific exchange

- Information fusion conference
- Journal of informaton fusion, Elsevier
- The 2004 information conference will be held in Stockholm, Sweden by FOI

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Conference on information fusion

- Theoretical and Technical Advances
  - Information modeling and learning, probability and statistics, fuzzy sets, bayesian, etc.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Conference on information fusion

- Theoretical and Technical Advances
  - Information modeling and learning, probability and statistics, fuzzy sets, bayesian, etc.
- Algorithms and Systems
  - Target detection and tracking, target recognition and classification, data association, sensor registration, situation assessment, network security, etc.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Conference on information fusion

- Theoretical and Technical Advances
  - Information modeling and learning, probability and statistics, fuzzy sets, bayesian, etc.
- Algorithms and Systems
  - Target detection and tracking, target recognition and classification, data association, sensor registration, situation assessment, network security, etc.
- Applications
  - Radar and communications, signal and image processing, robotics and control, decision aid, etc.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities)

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO)

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO), Canada

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO), Canada, UK (Qinetiq)

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO), Canada, UK (Qinetiq), Singapore (DSO Ntl labs)

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO), Canada, UK (Qinetiq), Singapore (DSO Ntl labs), France (ONERA), Germany, Sweden (FOI), and . . .

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Participants at FUSION

Even though information fusion is a function that is useful and in use in many different applications, the information fusion conference currently, in its childhood, still attracts particpants mainly from a small set of countries.

This year's conference attracted participants from mainly: USA (various companies and universities), Australia (DSTO), Canada, UK (Qinetiq), Singapore (DSO Ntl labs), France (ONERA), Germany, Sweden (FOI), and . . . Japan (AIST).

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models

In the world of IF, several models for fusion and decision making are in use. The most referenced are probably variations of the OODA-loop (Observe, orient, decide, acts) and the JDL-model.

OODA loop

Observe

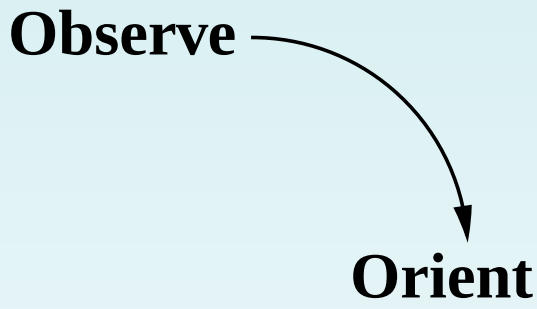
FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models

In the world of IF, several models for fusion and decision making are in use. The most referenced are probably variations of the OODA-loop (Observe, orient, decide, acts) and the JDL-model.

OODA loop



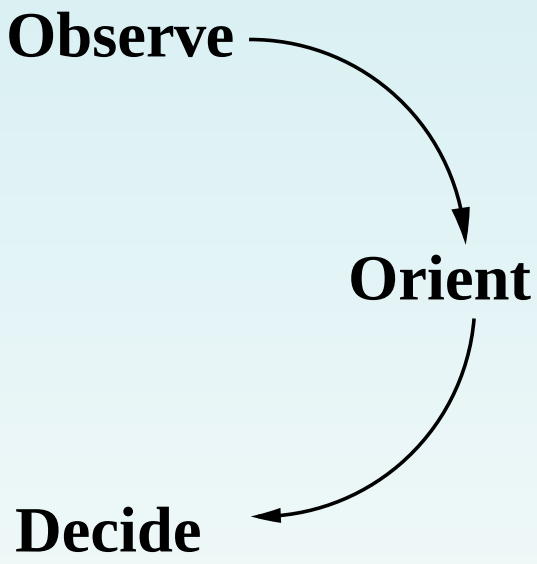
FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models

In the world of IF, several models for fusion and decision making are in use. The most referenced are probably variations of the OODA-loop (Observe, orient, decide, acts) and the JDL-model.

OODA loop

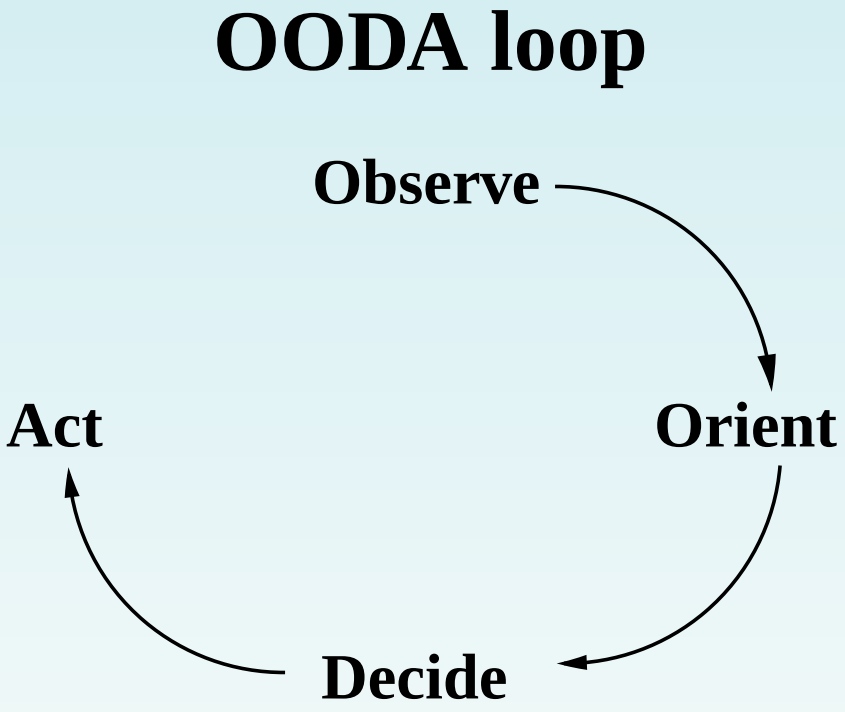


FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models

In the world of IF, several models for fusion and decision making are in use. The most referenced are probably variations of the OODA-loop (Observe, orient, decide, acts) and the JDL-model.



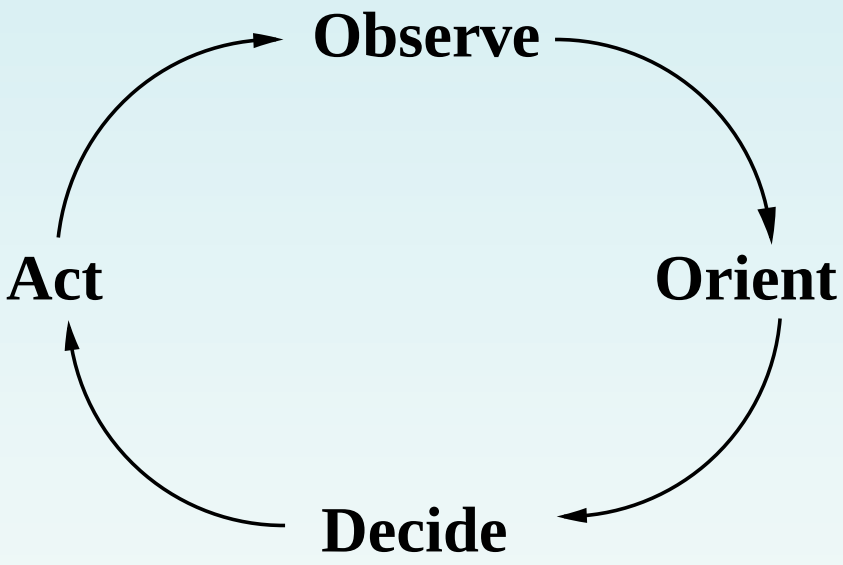
FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models

In the world of IF, several models for fusion and decision making are in use. The most referenced are probably variations of the OODA-loop (Observe, orient, decide, acts) and the JDL-model.

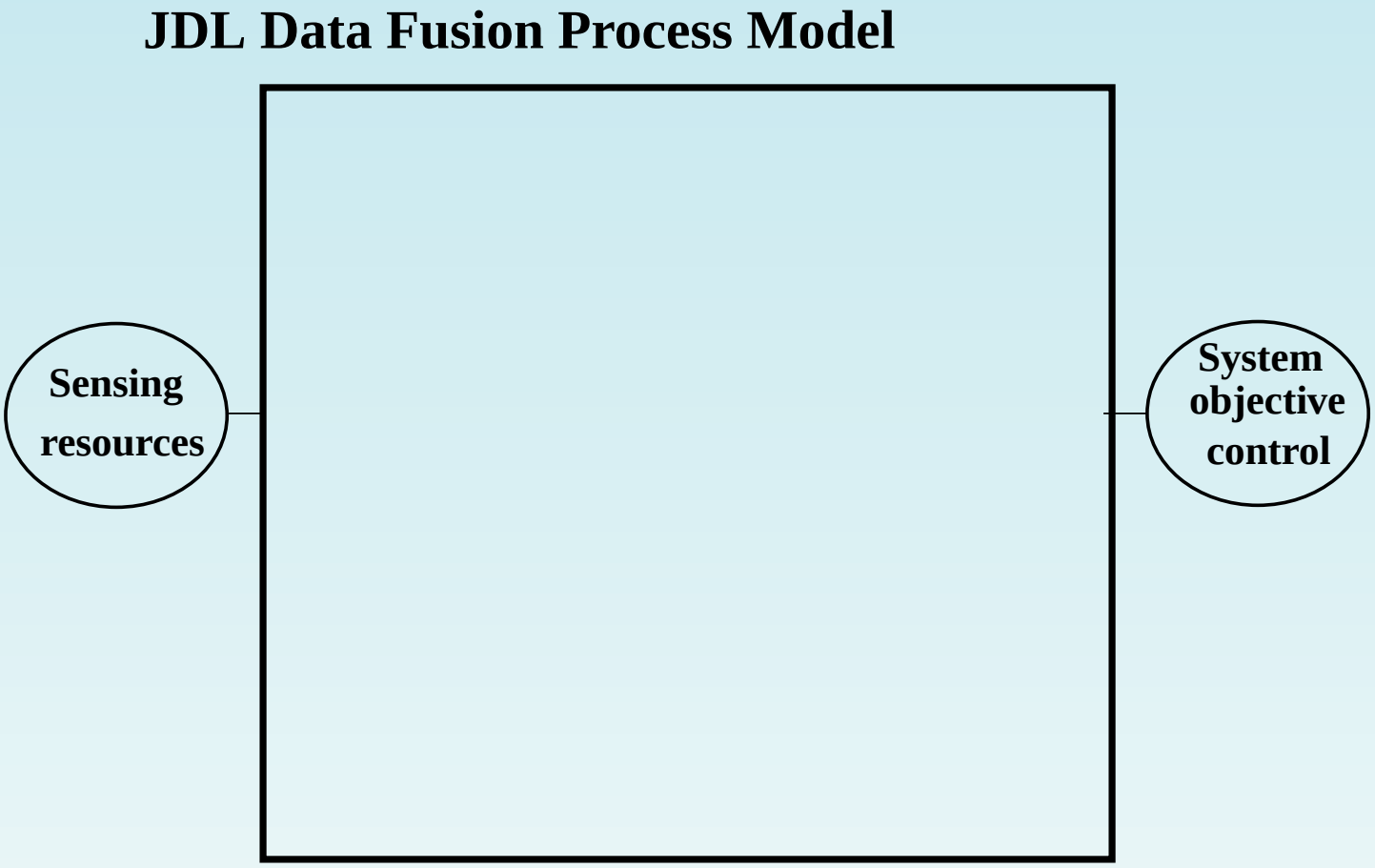
OODA loop



FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

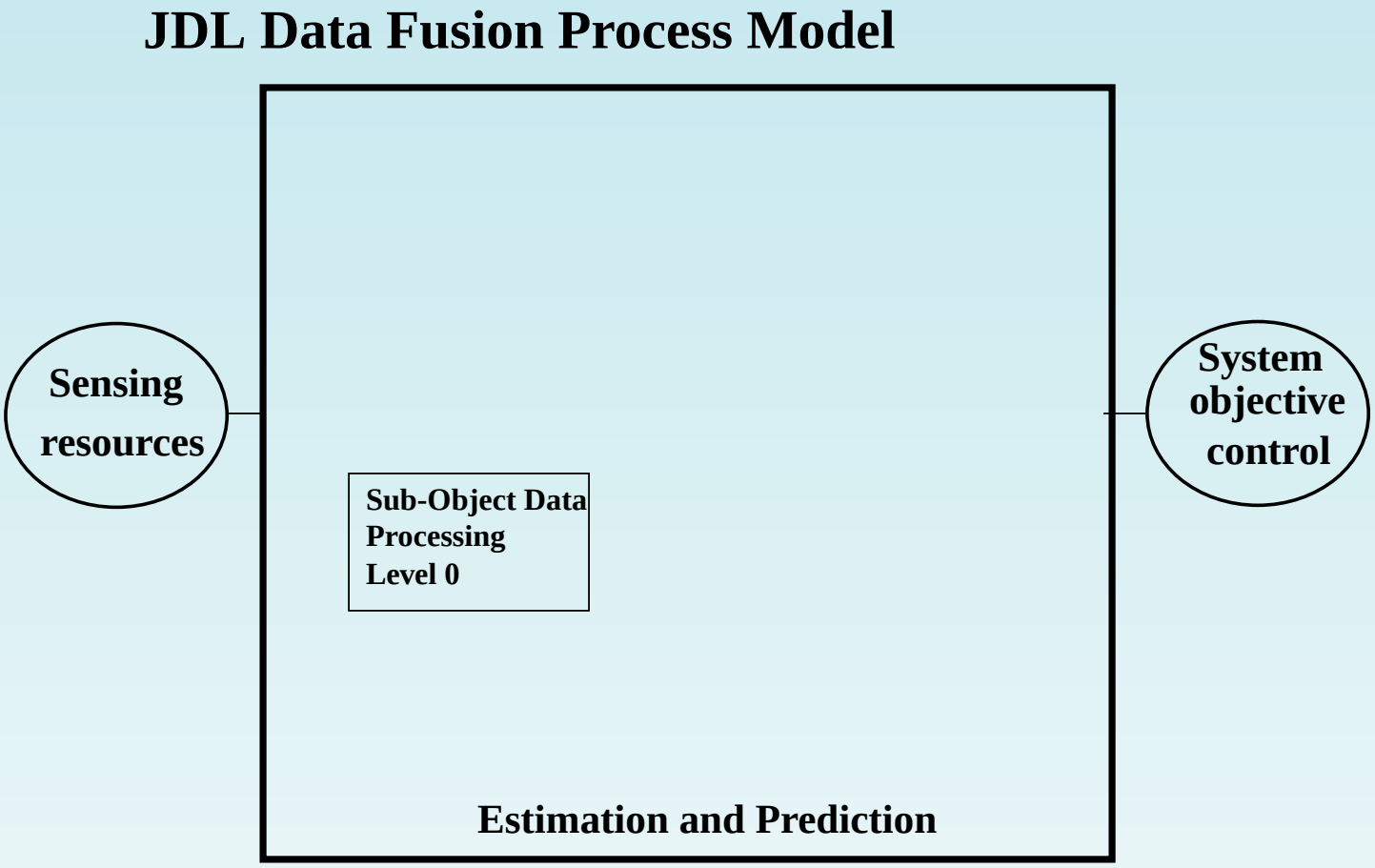
Information fusion models contd.



FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

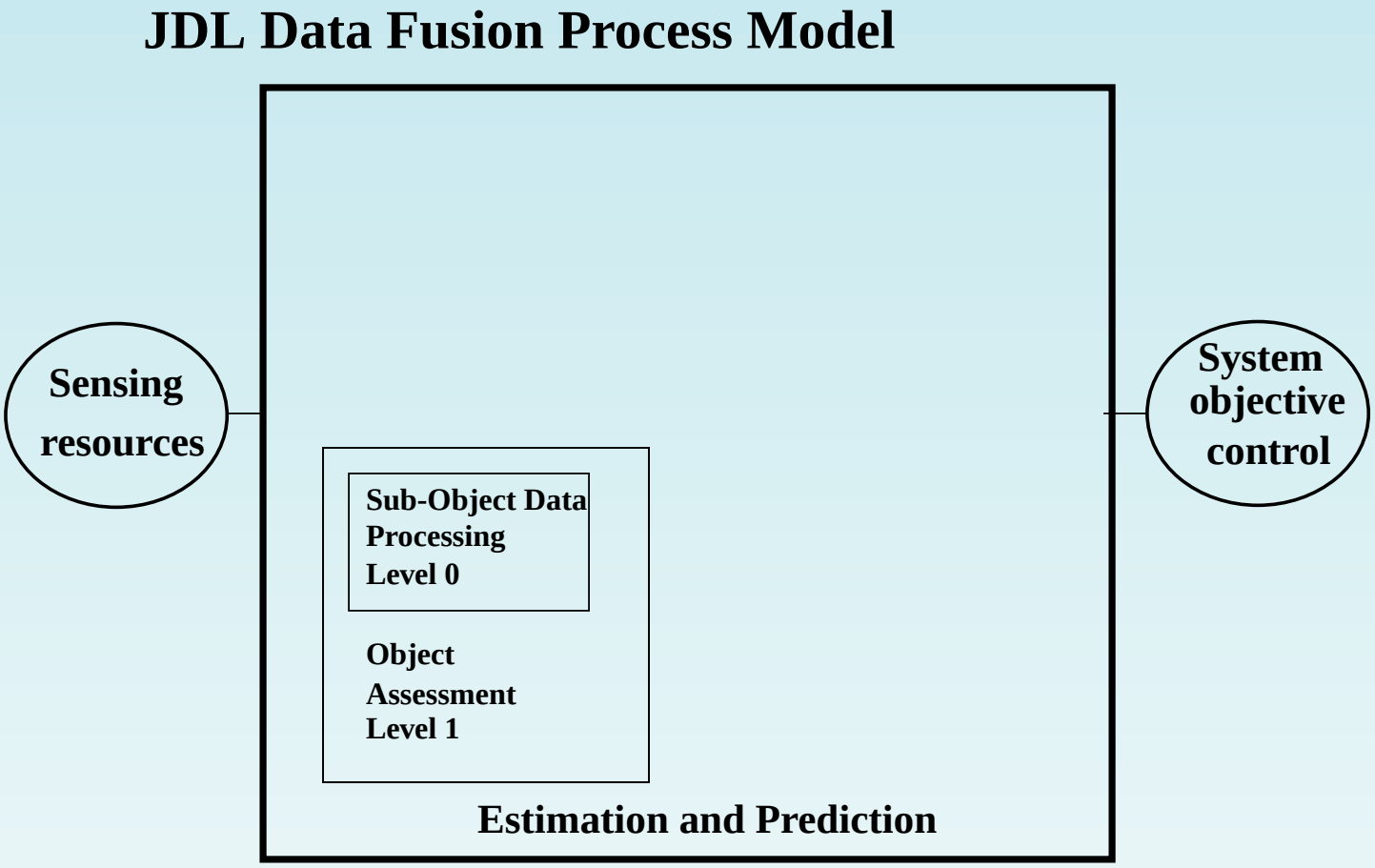
Information fusion models contd.



FOI SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

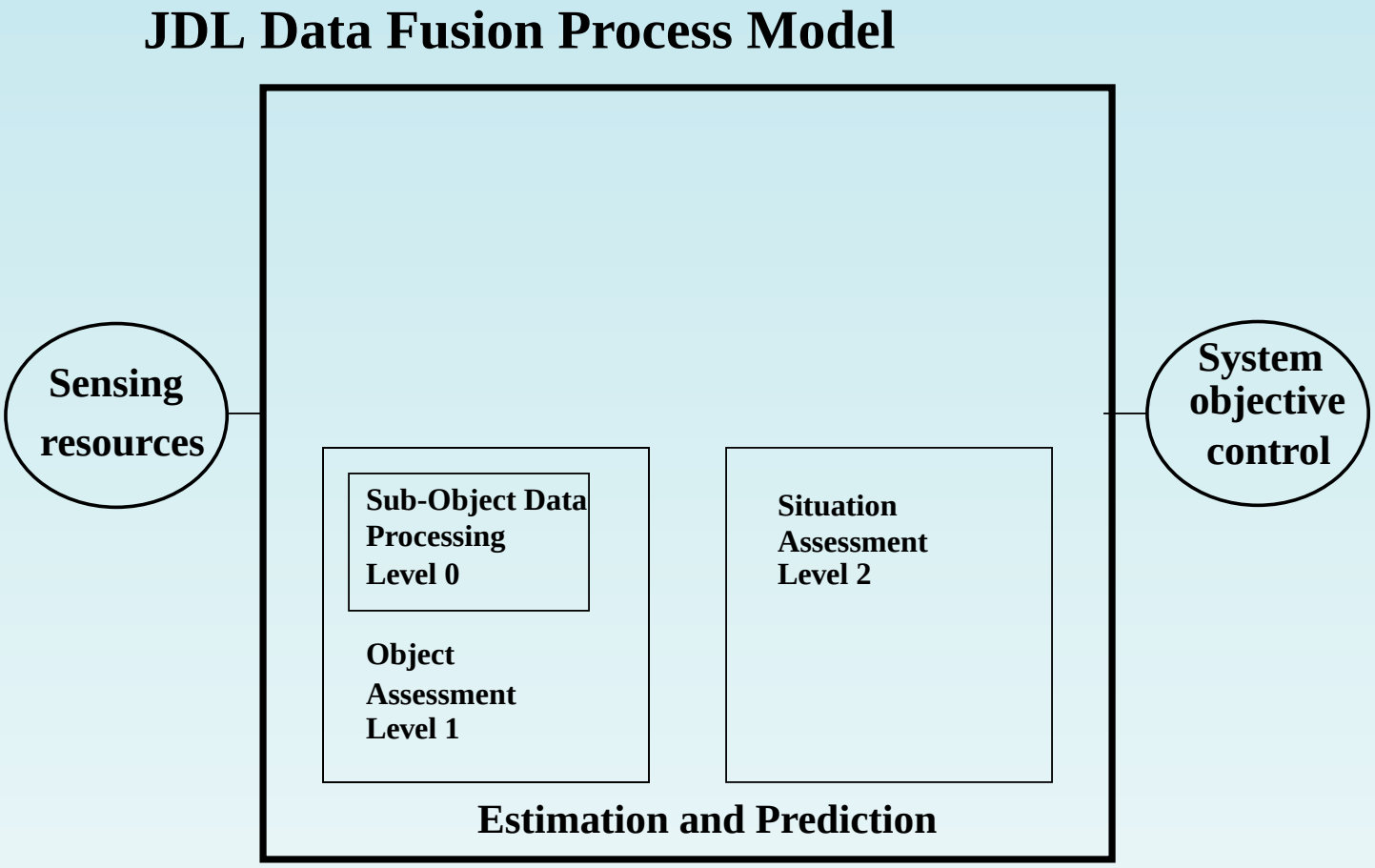
Information fusion models contd.



FOI SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

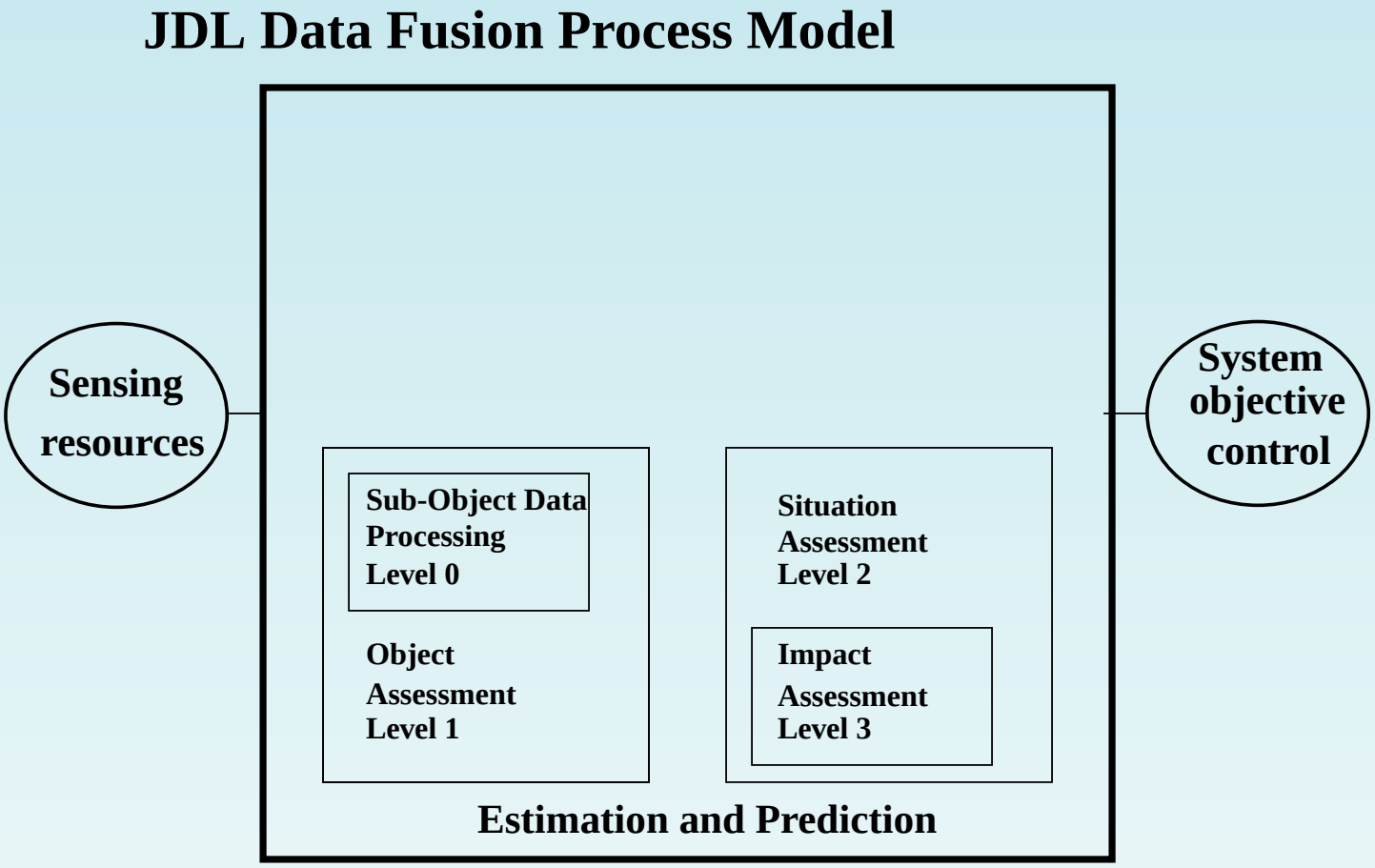
Information fusion models contd.



FOI SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

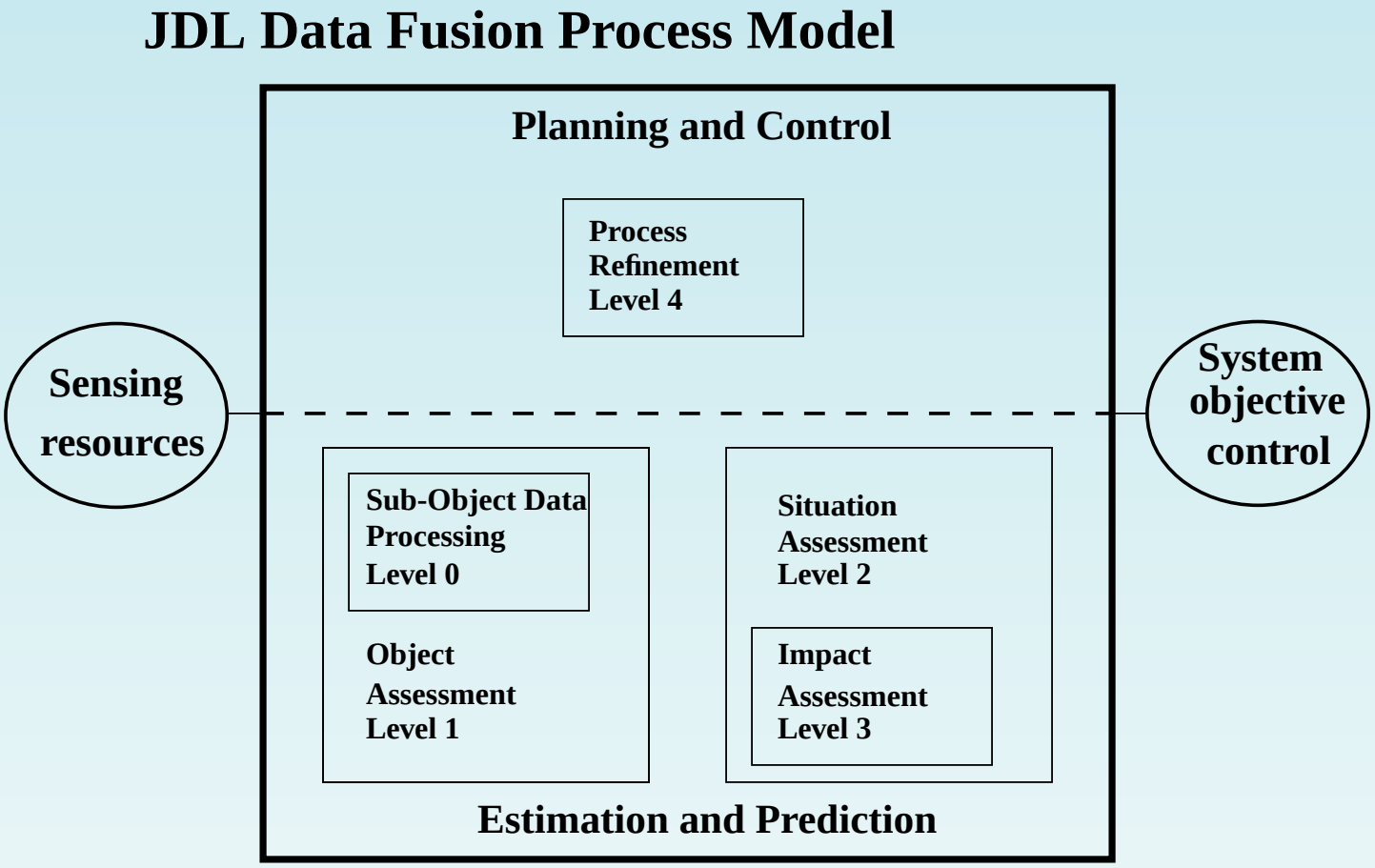
Information fusion models contd.



FOI SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Information fusion models contd.



FOI SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Data and information fusion in robotics and command and control

	Robotics	**Command and control**
Environment	indifferent	deceptive/responsive
Info sources	sonar, SICK, audio, etc	radar, intelligence reports
Sensor loc.	local	distributed
Applic.	Embedded systems	Decision support systems

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Essential references

Hall, David L., Llinas, J. Eds, *Handbook of data fusion*, CRC Press, 2001, ISBN: 0849323797

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems

Essential references

Hall, David L., Llinas, J. Eds, *Handbook of data fusion*, CRC Press, 2001, ISBN: 0849323797

Abidi, Mongi A., Gonzalez, Rafael C., *Data fusion in Robotics and Machine intelligence*, Academic Press, 1992, ISBN: 0 12 042120 8

FOI
SWEDISH DEFENCE RESEARCH AGENCY

Centre for Autonomous Systems