

# **Information Fusion in Internet World**

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# Opportunities and Challenges

- **Opportunities**
  - More data are collected by multiple means
  - Connectivity allows sharing of data/information
  - Computing power supports advanced processing
  - Decision makers need good information to make faster and better decisions
- **Challenges**
  - Information fusion technology (target tracking, target recognition, etc.) has made much progress in solving traditional fusion problems
  - Can information fusion address fusion problems in internet world

# Examples of New Fusion Problems

- **Information assurance**
  - Detecting intrusions
  - Tracking intruders
  - Assessing attacks
- **E-commerce**
  - Tracking customers and activities
  - Understanding behaviors and intent
  - Tracking fulfillment (shipping) process
- **Wireless communication**
  - Tracking cell phones

# **New Problem Characteristics**

- **Data sources**
  - **Data bases, not just traditional physical sensors such as radars, infrared**
  - **Accuracy of data source hard to assess**
- **Entities of interest**
  - **Not just vehicles or physical objectives**
  - **Activities and intent in addition to location, i.e., Level 2 fusion**
- **Entity models**
  - **Not just governed by physics**
  - **High uncertainty in many cases, e.g., hacker behavior**

# Information Assurance versus Traditional Battlefield Surveillance

<b>Conventional Battlefield</b>	<b>Cyber Battlefield</b>
<ul style="list-style-type: none"><li>• <b>Entities</b><ul style="list-style-type: none"><li>– Physical, e.g., vehicles, aircraft, equipment, weapons</li><li>– Slow dynamics</li><li>– Slowly evolving threat from limited known sources</li></ul></li><li>• <b>Environment</b><ul style="list-style-type: none"><li>– 3 dimensional physical space</li><li>– Physical terrain</li></ul></li><li>• <b>Sensors</b><ul style="list-style-type: none"><li>– Radars</li><li>– Imagery</li><li>– ELINT</li><li>– HUMINT</li></ul></li></ul>	<ul style="list-style-type: none"><li>• <b>Entities</b><ul style="list-style-type: none"><li>– Digital, e.g., computing actions, network actions</li><li>– Very fast dynamics</li><li>– Rapidly evolving threat from numerous unknown sources</li></ul></li><li>• <b>Environment</b><ul style="list-style-type: none"><li>– Cyberspace</li><li>– Computers and networks</li></ul></li><li>• <b>Sensors</b><ul style="list-style-type: none"><li>– Host monitors</li><li>– Network monitors</li><li>– HUMINT</li></ul></li></ul>

# Some Technology Challenges

- **Handling many types of data - text, image, video, etc.**
- **Exploiting advanced extraction techniques - natural language understanding, etc.**
- **Tracking and association of non-physical entities**
- **Inferring intent from tracks**
- **Reasoning with high uncertainty**
- **Learning models from data, e.g., data mining**
- **Distributed data fusion across large networks**
- **Interfacing with search techniques**