Multi-Sensor Data Fusion

Class 5: Applications

December 13, 2019 Louis W. Giokas







This Week's Agenda

Monday Tuesday Wednesday Thursday Friday

The Sensor Fusion Problem Algorithms Sensor Types Sensor Fusion Applications







Course Description

The use of multiple, heterogeneous sensors is often necessary. This is the case in areas such as robot control, autonomous vehicles and military aviation. Different skills are required including electrical engineering, computer science and statistics. These systems can be complex and include many control theory concepts. In this class we will go over the problem, describe the types of algorithms and sensors used and finally will give some examples.





Today's Agenda

- Overview
- Air Traffic Control
- Industrial Process

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- Automotive
- Conclusion

Information Classification: General



Overview

- Application areas for Multi-Sensor Data Fusion (MSDF) are diverse
 - We will look at three applications to show this diversity
 - This is just a small sampling as the field is very general
- There are many ways to look at the problem and many ways to solve it, as we have seen. These concrete examples help in understanding the topic







Overview

- We build up a picture of the situation in a layered approach to understand the environment and make decisions
- Sometimes there is a human in the loop and sometimes the systems are totally autonomous



- This is an application area with a long history
- The sensors are diverse, and complex
- There are few constraints on aspects like power, weight or communications
- This is a human-in-the-loop application
 - The HMI is a critical component and consumer of the fused information
- The trend is toward ever greater automation

































- In industrial applications sensors are a critical element
- They perform under harsh conditions in most cases
- Some of the constraints are:
 - Environmental
 - Safety
 - Cost
- These sensors are used to give a picture of the momentary state of the production process







- A model, based on the JDL (Joint Directors of Laboratories) fusion process is often used:
 - Object Refinement (Level 1)
 - Situation Refinement (Level 2)
 - Threat Refinement (Level 3)
 - Process Refinement (Level 4)
- The JDL model was originally developed for military surveillance types of applications







News Information Classification: General

ECT sensor





reconstruction



- Self driving automobiles (SDA), designed to operate without input from the driver, are a hot area of research for MSDF, and is perhaps the most recognizable application
- We will look at systems that act fully autonomously and as a co-pilot
- As we have seen, complexity comes in many dimensions
 - Physical environment
 - Sensors

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Device under control







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Centralized Processing Architecture



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Decentralized Processing Architecture





Conclusion

- Today we looked at three application areas of MSDF
- In the class we have looked at a number of aspects of the problem, including algorithms, sensors and systems
- Contact Information
 - Email: lgiokas@outlook.com
 - Twitter: @naperlou and #DNCEC





