Introduction

- Knowledge-based systems
  - University of Twente
  - First: Constraint-Based Reasoning
    - Planning, scheduling
    - Model-based resoning
  - Thereafter: AI in design
    - Case-based reasoning
    - Modelling design

At OU now

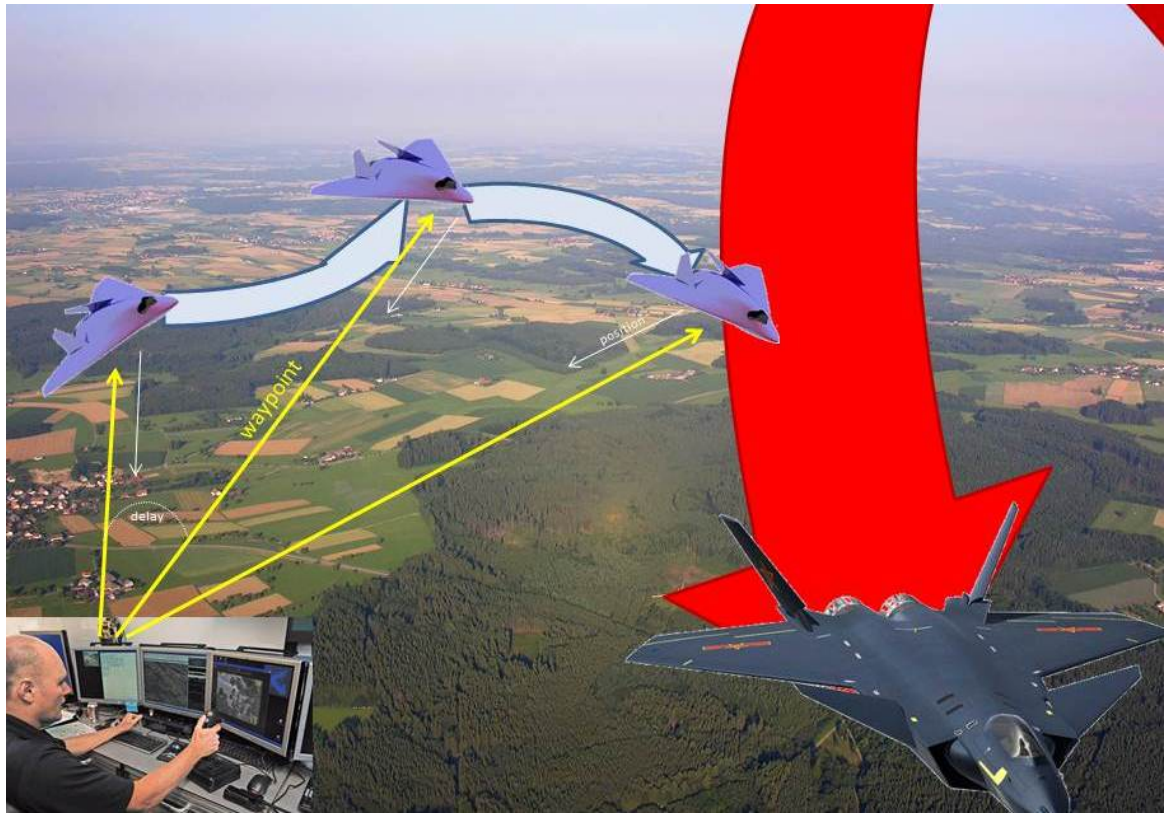
- T4SS

UAS against Air Threats

The Semi-Direct Control System

Frank Tempelman

Hans Heerkens



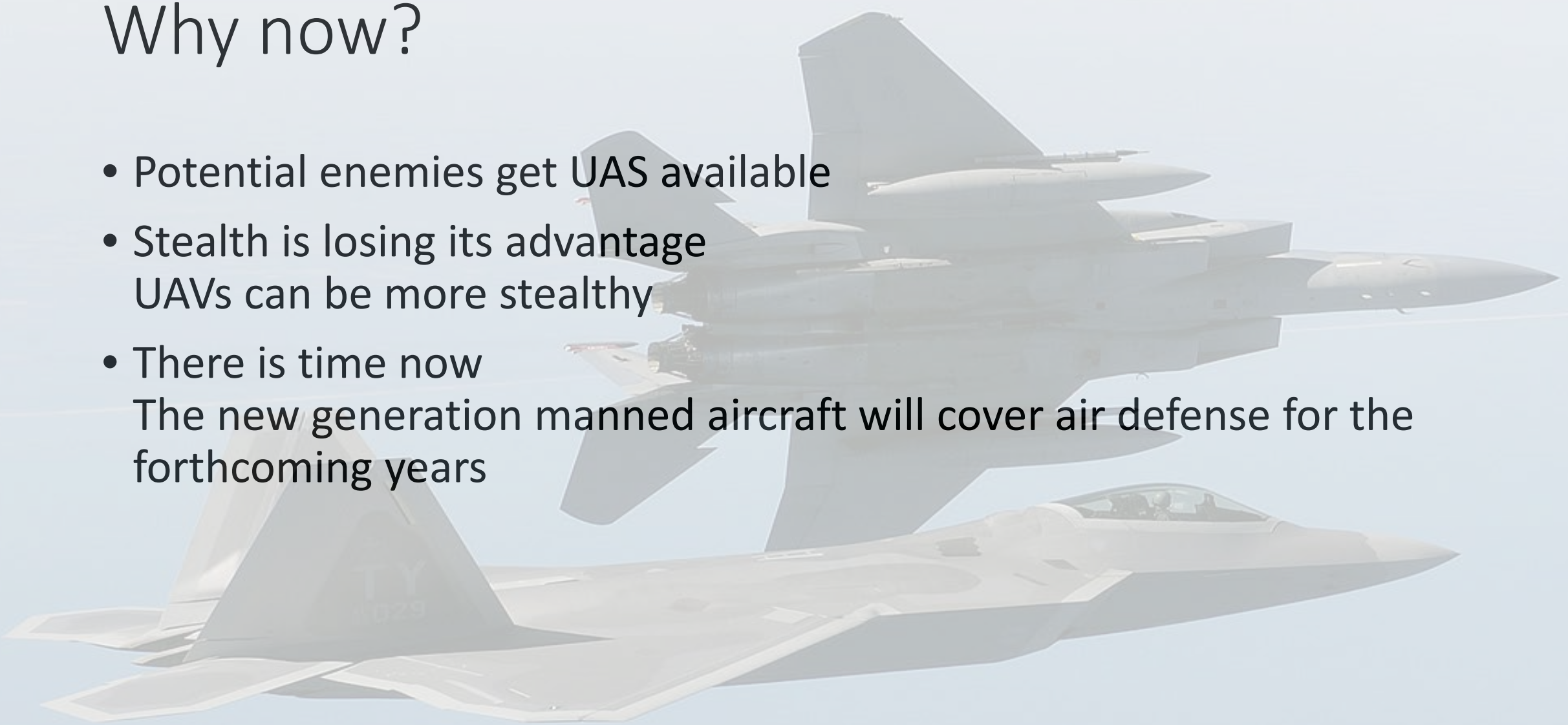
Overview

- Why?
  The advantages of using UAS against air threats
- Why not today?
  Current problems
- Solution
  The Semi-Direct Control System (SDCS)
- Evaluation and further research
  What have we achieved?
  What needs to be done?

Advantages of UAS against Air Threats

- Better maneuverability
  No limitations of the human body
- Better endurance, range
  No limitations of the human body
- Less susceptability to threats
  Laser, directed energy
- New technical possibilities
  E.g., Vertical Take-Off and Landing (VTOL), or flying very high, opening up new possibilities for air-to-air warfare

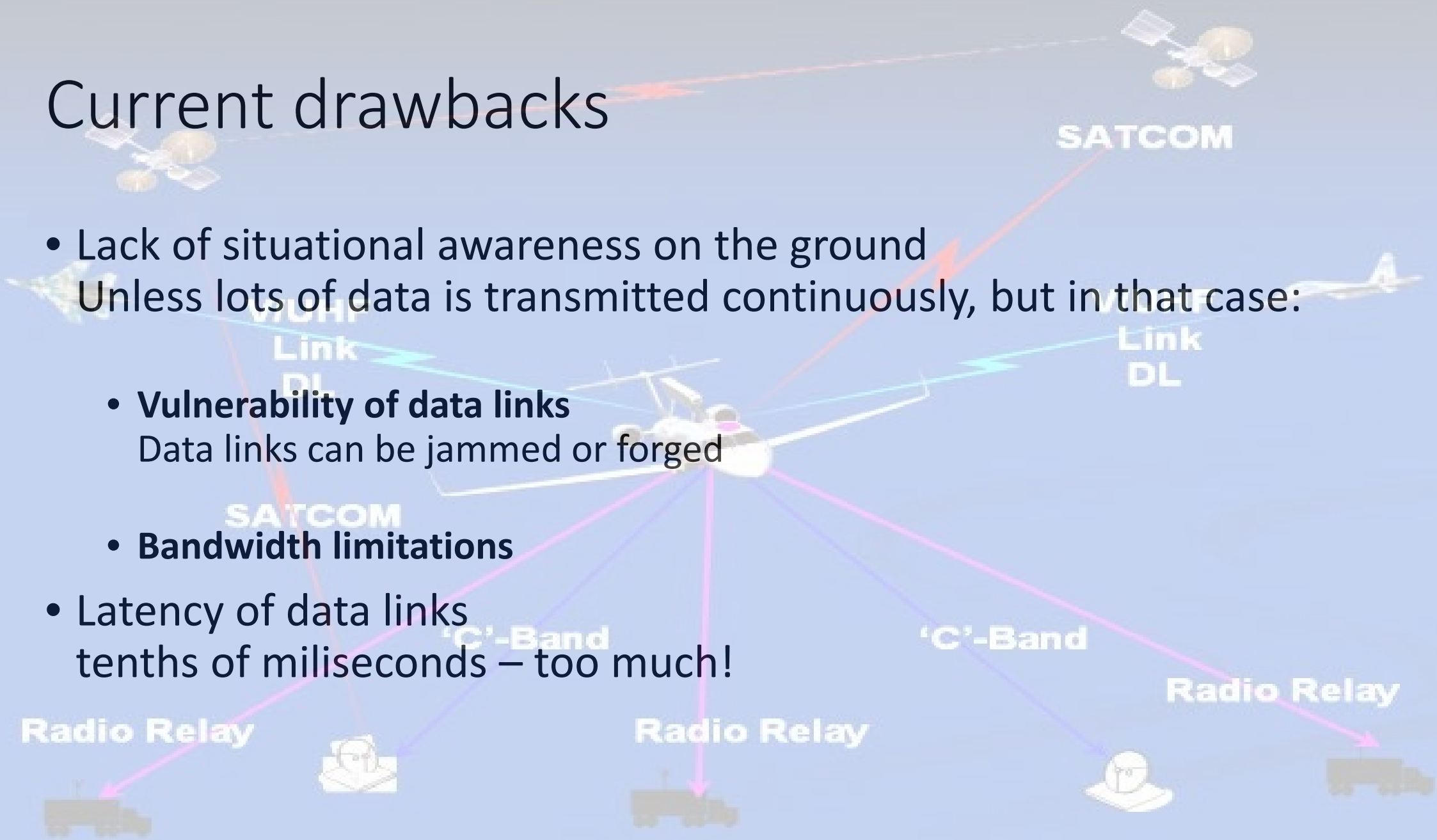
Why now?



- Potential enemies get UAS available
- Stealth is losing its advantage
  UAVs can be more stealthy
- There is time now
  The new generation manned aircraft will cover air defense for the forthcoming years

Current drawbacks

- Lack of situational awareness on the ground
  Unless lots of data is transmitted continuously, but in that case:
  - **Vulnerability of data links**
    Data links can be jammed or forged
  - **Bandwidth limitations**
- Latency of data links
  tenths of miliseconds – too much!



Semi-Direct Control System

- Intermittent instead of continuous input to UFAS
  - Maneuvering tasks
  - Relative position goals
  - Other tasks: attack, ...
- Converted to inceptor commands
  - By an ‘intelligent’ Flight Management System (FMS)
- Intervals between commands can vary
  - Correlated to needed/available intelligence in FMS

Human-Machine Interface

- Controller is located in a Virtual Reality (VR) environment
  - VR helmet? Pick-and-move?
  - New possibilities:
    - Visualize course of targets
    - Visualize no-escape zones
- Synthetic picture
  - Based on data, video, audio and other sensory cues from the UFAS and other platforms.
  - Less sensors needed!
    Small, agile, stealthy, silent
- Probably division of tasks between two or more controllers


interval time
interval time
position
position
fly-to
fly-to
attack
position
BOOM!!

Application

In situations where

- Quick reactions are needed
  e.g., because of obstacles and threats
- Direct joystick control not feasible
  due to datalink limitations

Air defense

Cruise missile and UAS defense

Ship defense

Counter-air and interdiction

CSAR

Escorting

To do

- Trade-off between interval length and intelligence
  - The larger the intervals, the more intelligence is needed
  - Research vehicle for autonomy!
- Trade-off between interval length and bandwidth
  - The larger the intervals, the less bandwidth is needed
- Human-Machine Interface
  - Virtual reality
  - Synthetic picture building
  - What information is needed on the ground?
- Training
  - Specific capabilities needed