

MDA 4.0 benefits, vulnerabilities and security aspects of the fusion process Rolf Müller, Head of Sales and Product Management CMS Prof. Dr. Koch, Head of Data Fusion, Fraunhofer FKIE

... a sound decision



MDA 4.0 benefits, vulnerabilities and security aspects of the fusion process Outline of presentation





Background Cyber Physical Systems





Semi-automatic, user controlled,

redundant, centralized architecture,

Special HW & SW & Tools

Tactical Data LINK

Military Hardware (Full Control) Fully automatic (Sensor Data Fusion, Tactical Situation Analysis, Threat Evaluation, Weapon Control), Fully distributed system, high redundancy, Publish / Subscribe Middleware, COTS based

Multi Link System, C4I



Model Based System Engineering, Open Source Middleware, OMG Standard, high focus on usability and user control.

IT Security

Multi Link System, C4I

COTS / civil products

New Threats



Background

Semantic Web Privacy, Security

Web Services



Application

Mobile

Orchestrated & Configured & Standardized

Handcrafted

New Threats

Open Source / Commercial Development Environment



Handcrafted



Military Host Development Environment

Address Decision Decisio

Frameworks



Trends in Maritime Security



New Threats

- Remote Sensing
- Unmanned Systems
- Autonomy
- E-Maritime
- Networked





Features of state of the art CMS systems



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Evolution – Next Generation CMS



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New level of situational awarness

Evolution of CMS

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Integration of Assistance in CMS Domain







Need for logical and reliable assistance that

- exploits large sensor data streams,
- makes context information accessible,
- uses of the heterogeneous sensors,
- checks plausibility of sensor information,
- suggests options to act properly,
- helps respecting constraints of action,
- adapts to the intention of the user.

in general: unburden humans from routine and mass task to let them do what only humans can do – acting responsibly.





Data to be fused: imprecise, incomplete, ambiguous, unresolved, false, deceptive, hard-to-be-formalized, contradictory, ...

FKIF





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Fusion Engines – Link between Sensors, Context, Action





An often implicitly assumed, but *decisive* prerequisite:

Integrity of Sensor and Context Data Do the data correspond to the expectations?

- Signals
- Measurements
- Classifified tracks
- Situation vignettes
- Mission data

Fusion may turn to confusion, management to mismanagement.

- unintended malfunction
- malign intervention

- unreal artefacts
- blind spots of Al

Fusion when sensor data are potentially corrupted







Methodological Core: Five Pillars

- Statistical Estimation
- Combinatorial Optimization
- Statistical Decision Making
- Machine Learning: AI
- Control and Game Theory

Highly developed, mathematically founded knowledge

Boosting: ITC and Platform Technologies economy-driven: deep learning



Paradigm Deep Learning

- Neuronal networks: long been known
- Boost: massive data, GPUs, tensor flow
- Correlation only: no *Tell me why*?
- Purely phenomenological approach
- Problem: prior knowledge only via data

Paradigm Bayesian Reasoning

- Logical reasoning under uncertainty
- Probable causal chain structures
- Systematic algorithm design
- Physical, context, expert knowledge
- Not yet a "perfect" hardware

Currently under research:

Bayesian Deep Learning

- Represent uncertainty
- Use of stochastic methods
- Incorporate context data
- Probabilistic MoP, MoE
- Origins in the 1990ies
- Problems: scalable, big data



Al for Combat Management

→ common, role-oriented situation pictures

Prerequisite

to lead, to protect, to act

based on:

multifunctional sensors mobile sensor platforms comprehensive networking

Key role:

system-secure multiple sensor / platform / effector networks

0 b S e r V e р r 0 t e С t a С

mission, environment





Future Combat Management







Future Combat Management







Combat Management Systems Design: dominated by artificially 'intelligent' data exploitation in comparison to classical hardware.

Individual sensors: embedded into multiple sensor systems of mutually complementary and heterogeneous sensors.

Multifunctionality: predominant factor, i.e. the shared use of the same sensing hardware to achieve several specialized goals.

Place emphasis on data integrity aspects! Comprises navigation and cyber security.

Emerging Sensor Fusion Engines: "cognitive" w.r.t. scenario and mission requirements, massive external knowledge bases.



National Testbed: Scenario



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Laboratory at WTD81, Greding, Germany





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