Fire Control Units for Thermal Weapon Sights

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Agenda

1. Motivation
2. Mathematical model
3. DSP fire control computer
4. Results and experiences
5. RangIR applications
6. Conclusion

Motivation

Past

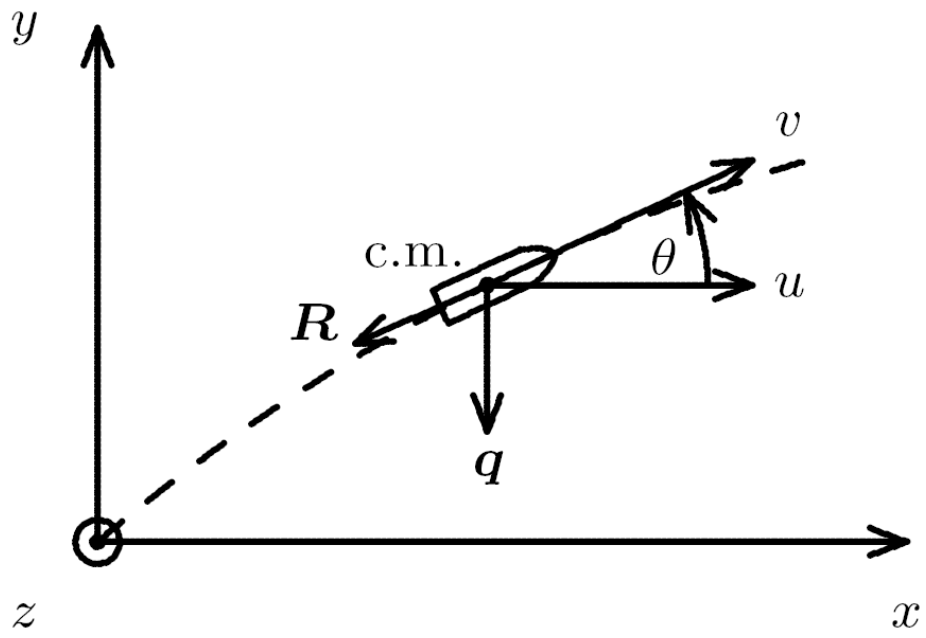
fire control for complex weapon systems

Present

fire control for light supporting weapons


IdZ-ES
Equipment: An overview
RHEINMETALL DEFENCE
Recce Equipment
Recce Projectile
Thermal Sight
Weapon Accessory Equipment
Video Visor
Thermal Visor
Core System
Headset
(active, with earprotection)
Core Computer
Battery Pack
SM-bus compliant)
avigation System
(GPS + inertial)
Group Radio (UHF)
Control Unit / Auxiliary Display
Cabling
(Warning Sensors)
Helmet System
Digital Magnetic Compass
Helmet with Ballistic Cover
Helmet Display
alternatively:
Night vision Goggles
Commander Equipment
Troup Radio (VHF)
Portable Control Computer (TFR)
Clothing, Protection and Carrying System
- Combat Dress
- NBC - Protection
- Thermal Protection
- Rain Protection
- ball. Protection
- Carrying System
Base Station / Vehicle Adaption
Adaption FüInfoSys / IFIS Group Radio
MIP

mathematical model



$$M\dot{\boldsymbol{v}} = \boldsymbol{q} + \boldsymbol{R}$$

$$\frac{\mathrm{d}u}{\mathrm{d}x} = -\frac{R}{M}\frac{1}{v}\,,$$
$$\frac{\mathrm{d}p}{\mathrm{d}x} = -\frac{g}{u^2}\,,$$
$$\frac{\mathrm{d}y}{\mathrm{d}x} = p\,,$$
$$\frac{\mathrm{d}t}{\mathrm{d}x} = \frac{1}{u}\,.$$

mathematical model

fire control algorithm

- **Point mass model** according to NATO STANAG 4355 Appendix G
- **atmospheric data extrapolation** according NATO STANAG 4044
- **power drag law**
- **Gravity calculation** according to WGS84
- **Coriolis approximation** according to McCoy
- **crosswind considered** by Didion‘s formula
- **spin caused deflection** according to NATO STANAG 4355 Appendix G

mathematical model

fire control algorithm

- Equations of motion transferred to range regime
- numerical solution using RK4 intergration scheme for inital value problem (inner loop)
- boundary value problem solved by secant method (outer loop)
- vacuum solution used as inital value estimator

DSP fire control computer

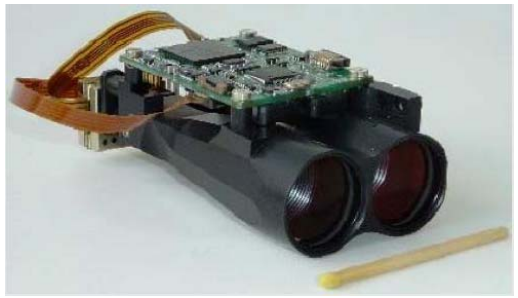
Sensor based input
- azimuth
- elevation
- cant
- range

fire control algorithm

User supplied input
- temperature
- pressure
- wind
- latitude

3D digital magnetic compass

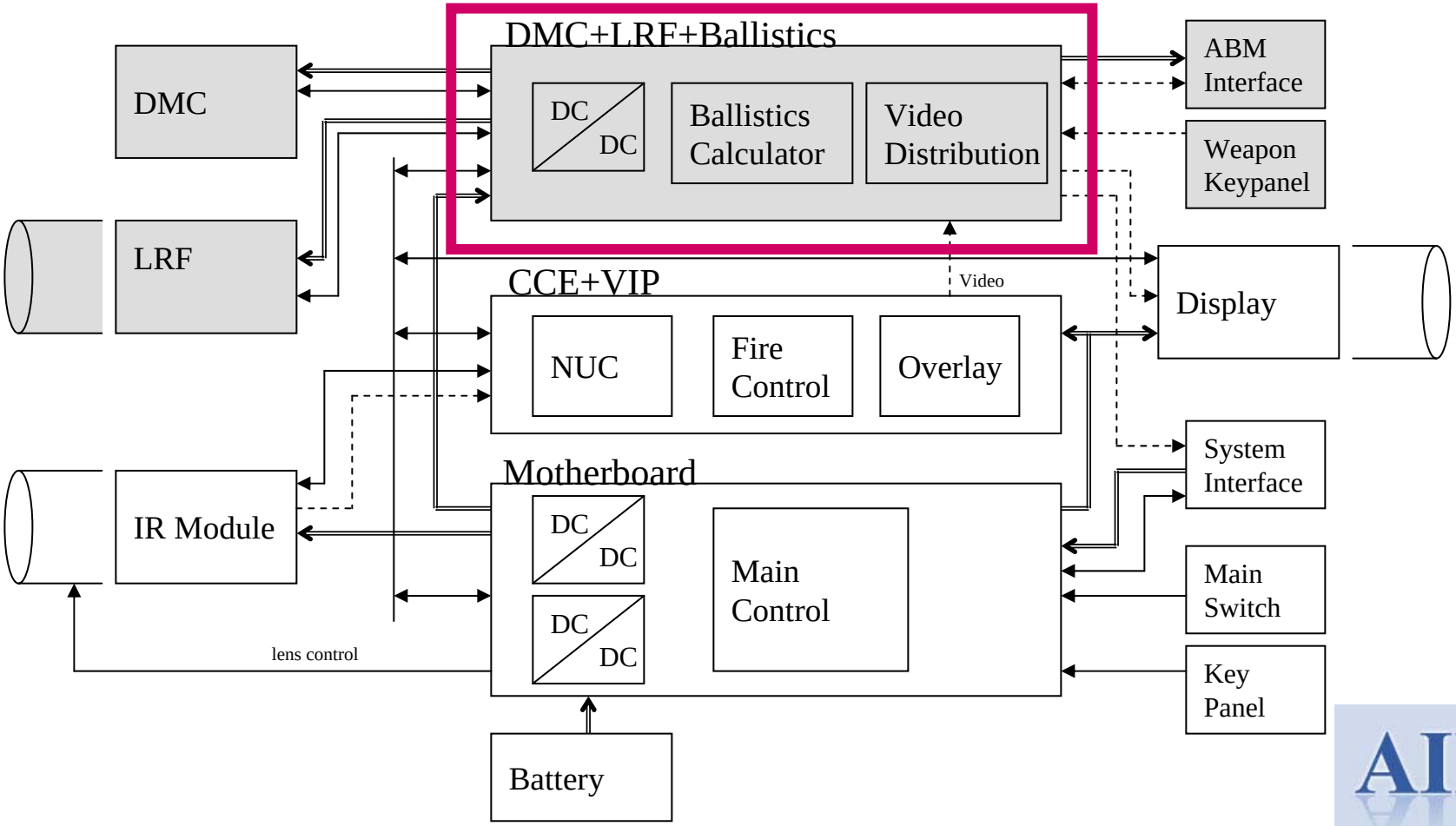
Laser range finder



weapon data output
- time fuze settings
- aiming point

DSP fire control computer

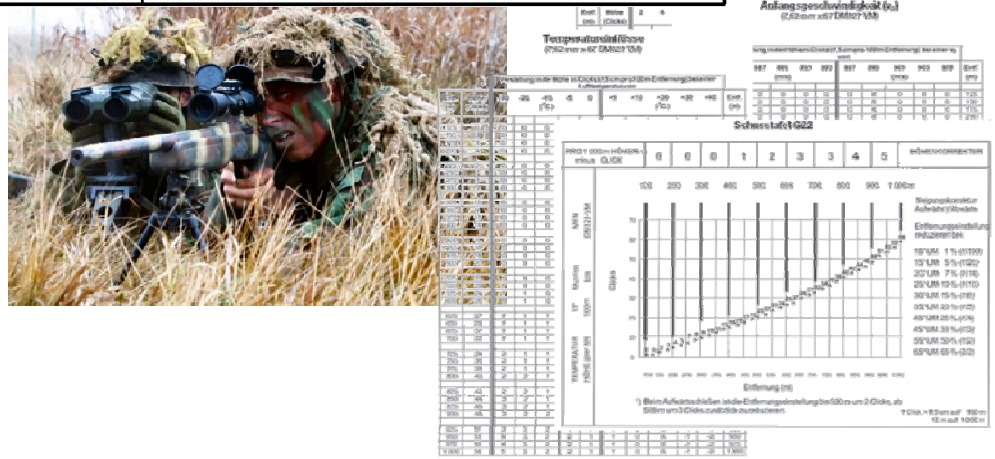
ballistic computer on digital signal processing card



Results and experiences

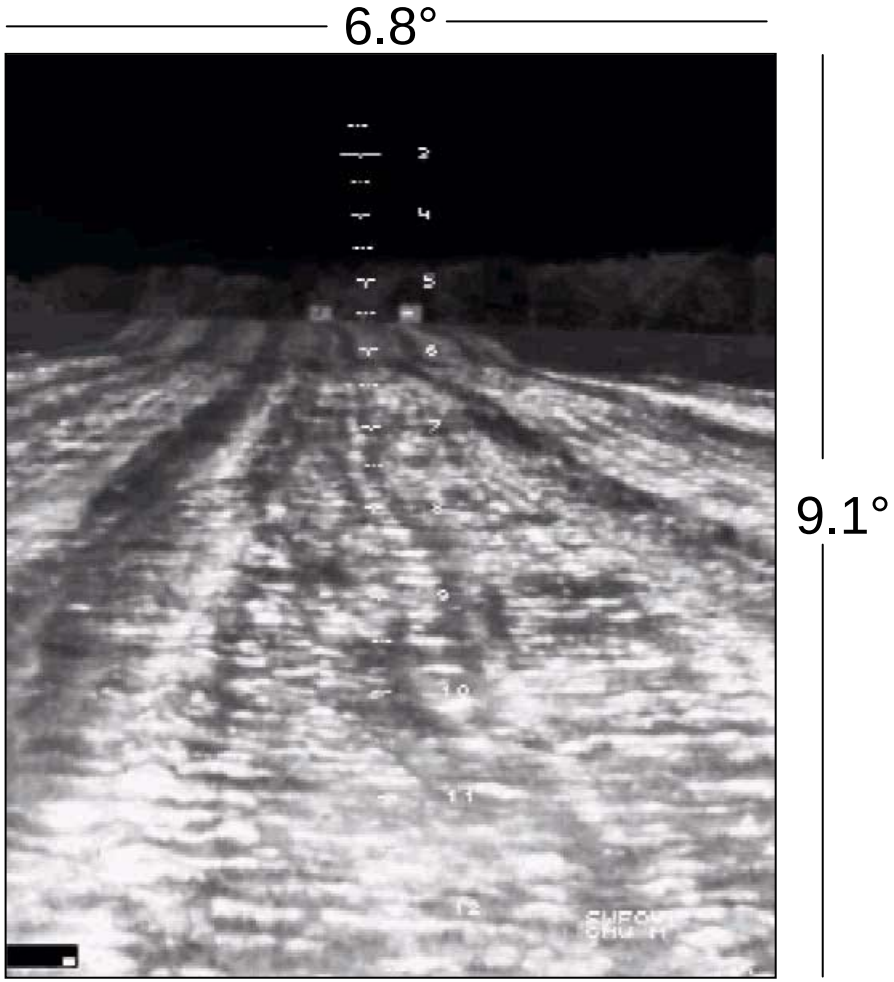
Comparison of the fire control algorithm with ballistic tables

Parameter	Average deviation, %
Elevation	1.13
Time of flight	0.52
Wind, *Coriolis* force, spin	16.05
Height of crest	0.66
Target velocity	0.44
Angle of fall	2.38



Results and experiences

RangIR used as Fire Control Unit for the 40 mm GMG



WBZG* for the German IdZ+

HUNTIR ZIELGERÄT FÜR DEN IdZ

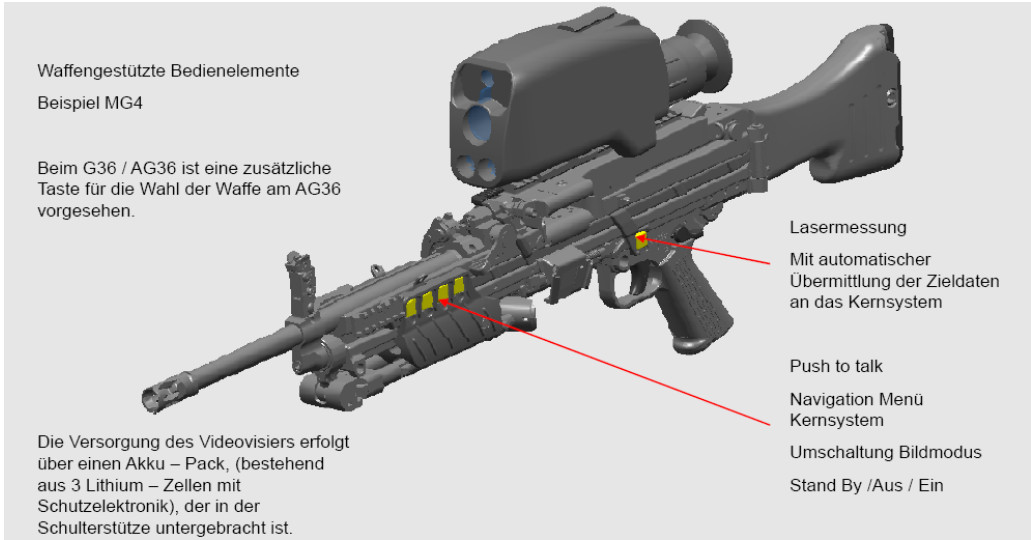
** Infrared sighting mechanism*

+ Infantrymen of the Future

RangeIR applications

RangeIR
with integrated fire control computer on cal .50 BMG rifle

RangeIR
with integrated fire control computer on 5.56 mm light MG



RangeIR applications

5.56

5.56

range < 1500 m

7.62

cal. 5.56 – 40 mm

12.70

time fuze option

40.00

Conclusions

Improved effectiveness of light supporting weapons

- *high first hit probability*
- *very successful test firings*
- *part of German project IdZ (Infantrymen of the Future)*

Follow-ons

- *conformance to MISRA-C and DIN EN ISO 61508*
- *live firings to test firing uphill and downhill*

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