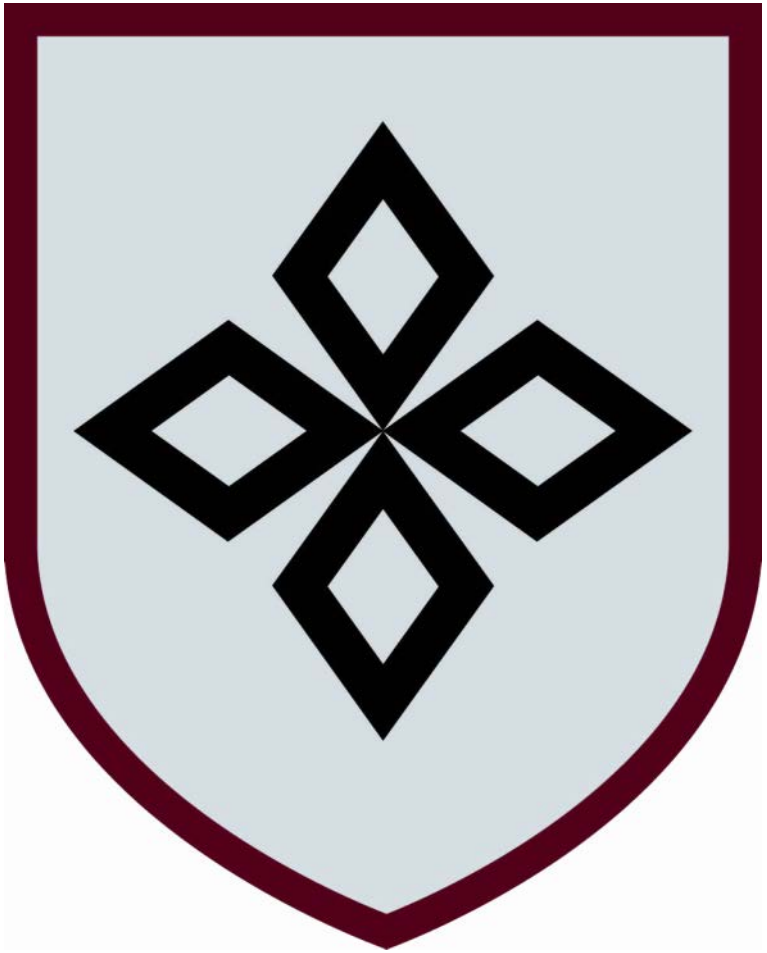


Bundeswehr Office
for
Defense Planning

MSG-143 “VBS 3 as an Analytical Tool (Potential, Feasibilities and Limitations)”

Col (GS) Soenke Marahrens

03.10.2016

VBS3@Planungsamt has been an offer

Bundeswehr Office for Defense Planning

Division IV 3 in cooperation with

der Bundeswehr Universität München

- Prof für Economic Computer Science
- Prof for Applied Mathematics

Helmut Schmidt Universität
Universität der Bundeswehr Hamburg

for Students (Junior Officer) of both German Armed Forces University

Military Training Systems

- Classification schema from Curry, Price, Sabin: „Commercial Off-the-Shelf Technology in UK Military Training“, 2016.

	live simulation	virtual simulation	constructive simulation
weapons/ vehicles/ terrain	**real**	**simulated**	**simulated**
troops	**real**	**real**	**simulated**

Computer-based Conflict

- Initial situation:
  - Virtual Battlespace (VBS) is used by many Armed Forces as battlefield simulator from 1st or 3rd person perspective
  - German Armed Forces uses VBS for
    - Training of soldiers (computer network of several player, team RED vs. BLUE)
    - Ex-post simulation/rehearsal of missions/events

A Constructive Approach Study - Team 1

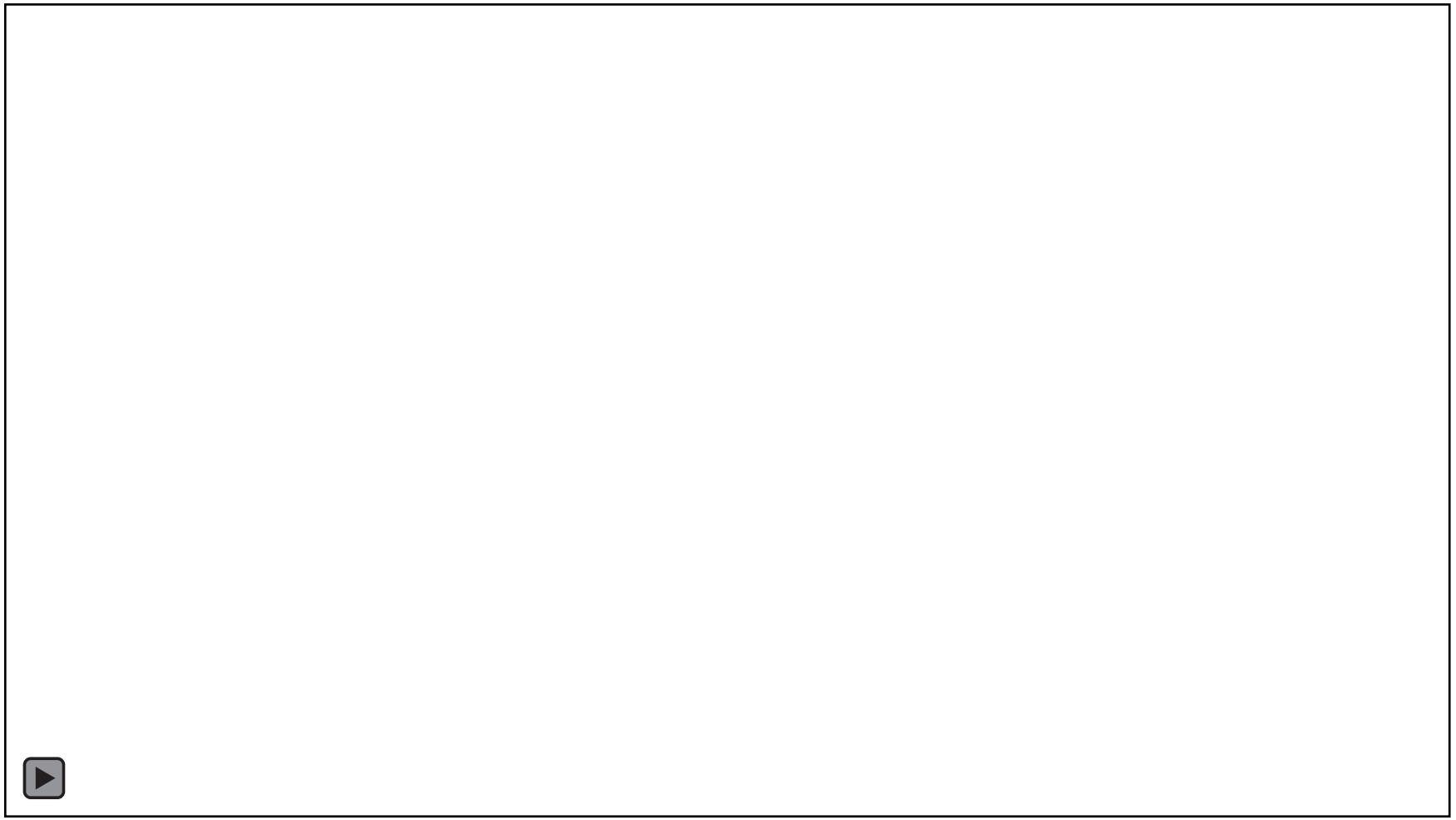
- To explore the **analysis capability**, **usability** and **realism** of the software, we took a closer look to the software's models of:
  - **Soldiers**
  - **Vehicles**
  - **Weapons**
- Our **approach**:
  - Develop **testbeds** for series of **experiments**
  - Understand the software
    - **Ability powers**
    - **Limitations to realism**
    - **Analysis capacity**

Focus of **Soldiers** Study

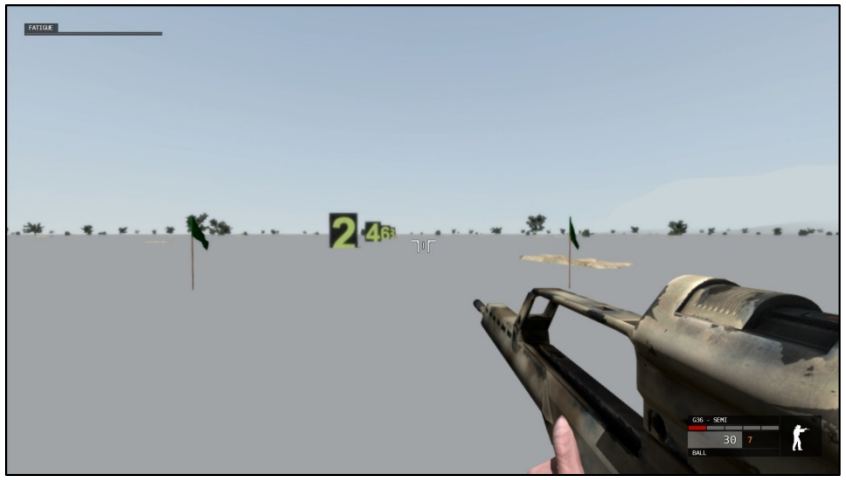
➔ *What are the dependences of a soldier‘s running speed and exhaustion?*

- **Weather**
  - Fog, rain, snow
- **Terrain**
  - Street, countryside, snow
- **Equipment weight**

Testbed of **Soldiers** Study



Testbed of **Soldiers** Study



Aim and Results of **Soldiers** Study

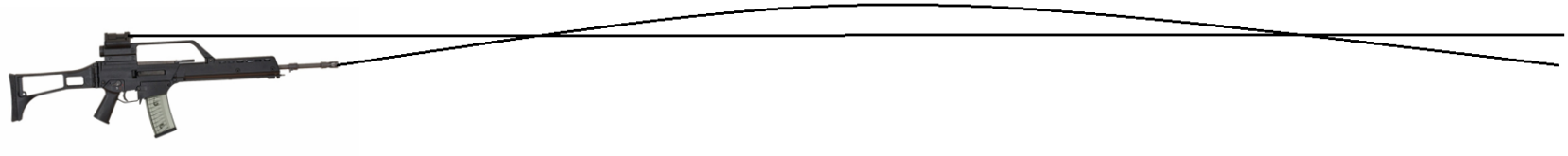
- *What are the dependences of a soldier‘s running speed and exhaustion?*
- We tested the influences of **weather** (fog, rain, snow), **terrain** (street, countryside, snow), **weapon carry mode** and the **equipment weight** by changing these parameters one by one on a dedicated racetrack of 100m.

➔ Results: **weather**, **terrain**, **weight load** and **weapon carry mode barely influences** soldier’s movement & exhaustion (only exception: 1,50m snow)

Focus of **Weapons** Study

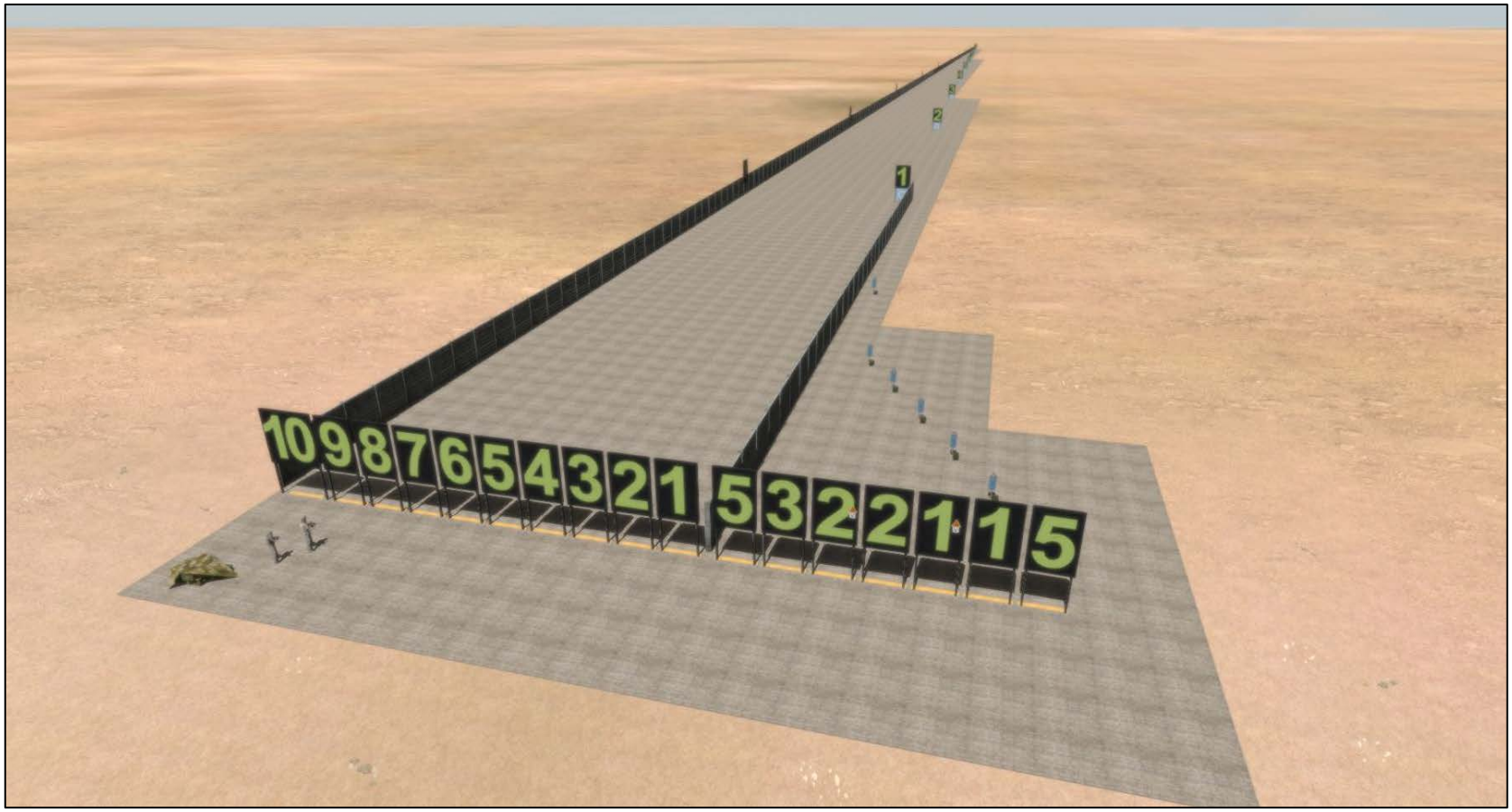
➔ *Are the software's models of weapon ballistics conforming to expectations?*

- Projectiles' flight paths
  - Ballistics
  - Influence of weather
- Sights of the H&K G36
  - Reflector sight
  - Telescopic sight

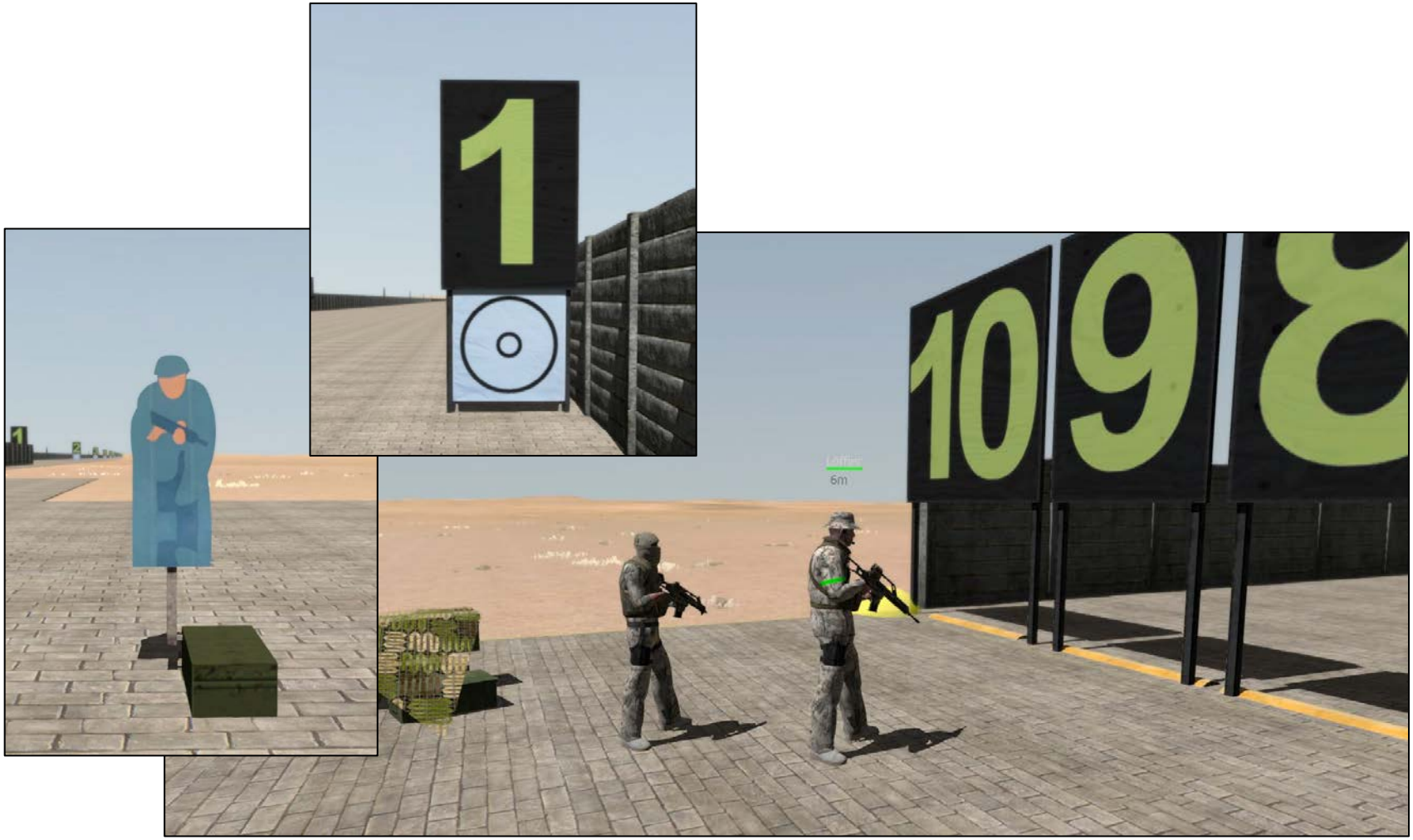


Testbed of **Weapons** Study

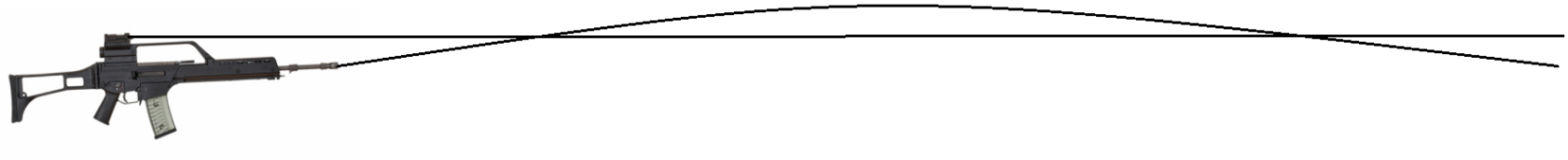
Testbed of **Weapons** Study



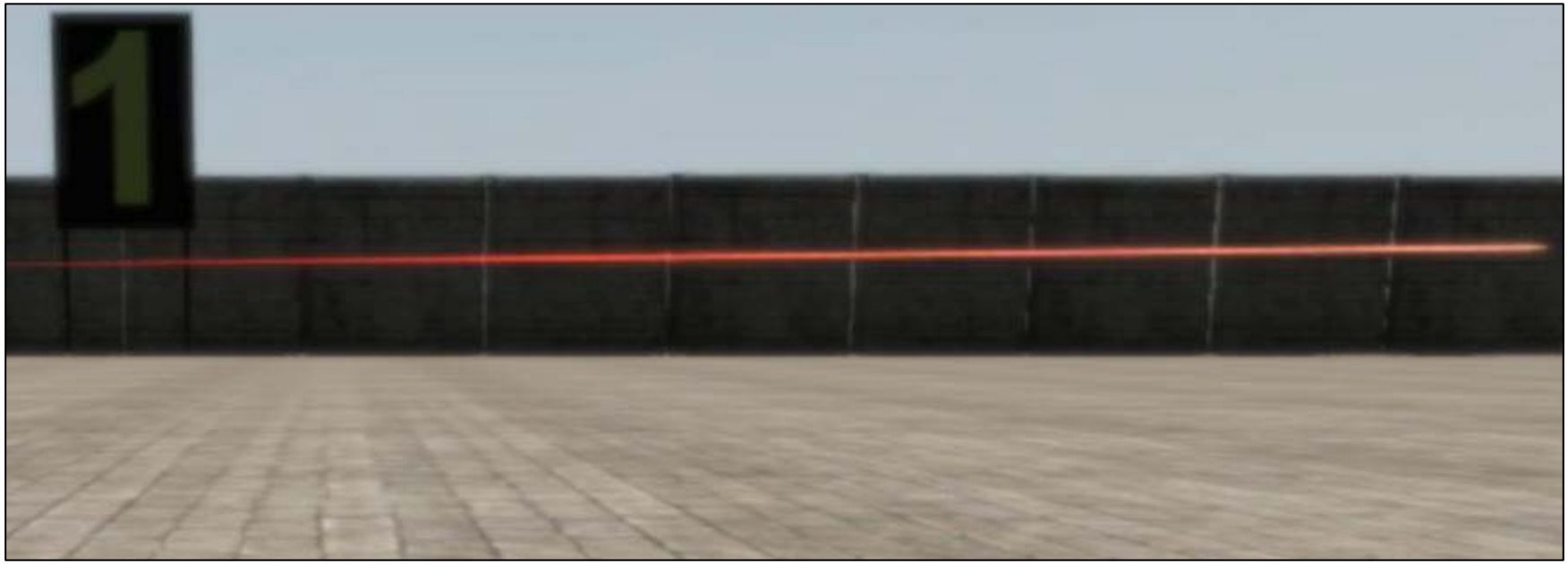
Testbed of **Weapons** Study

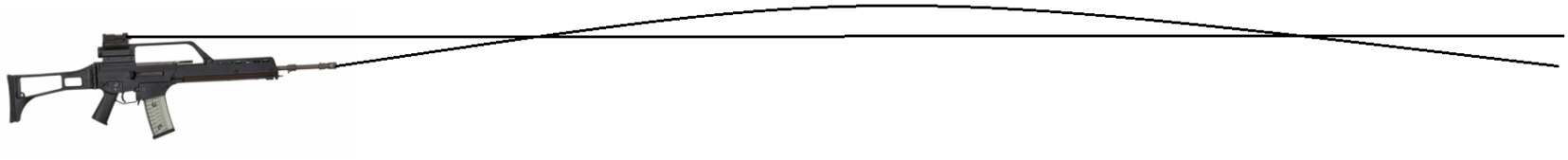


Experiment of **Weapons‘ Ballistics**



Experiment of **Weapons‘ Ballistics**





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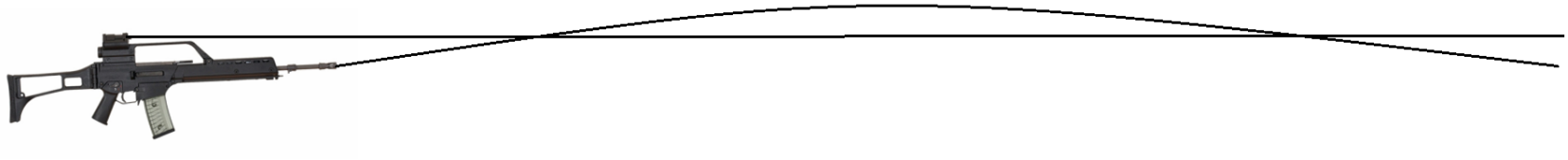

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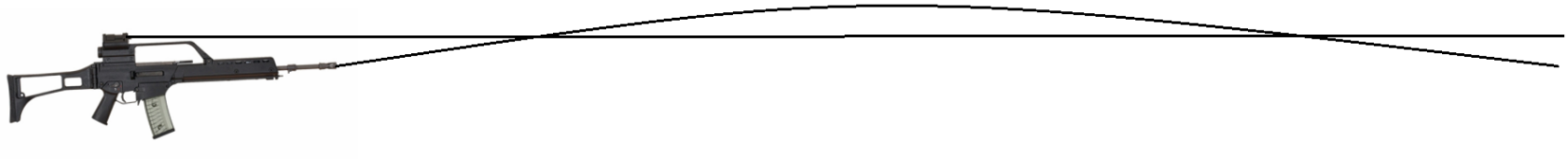
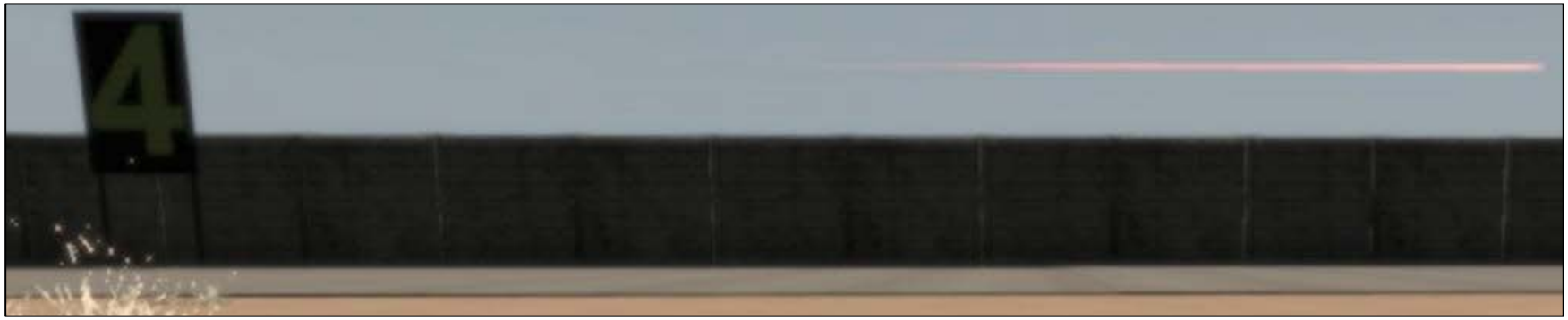
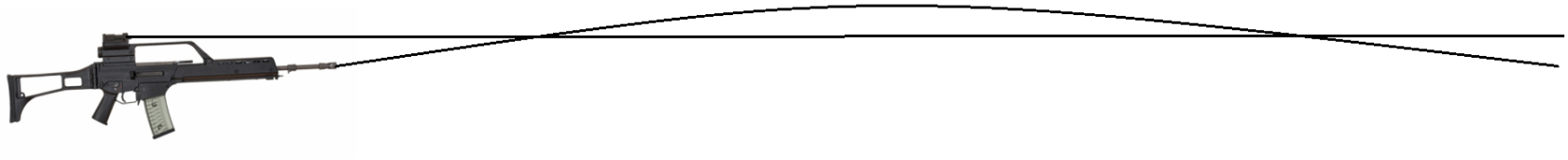


Experiment of **Weapons‘ Ballistics**





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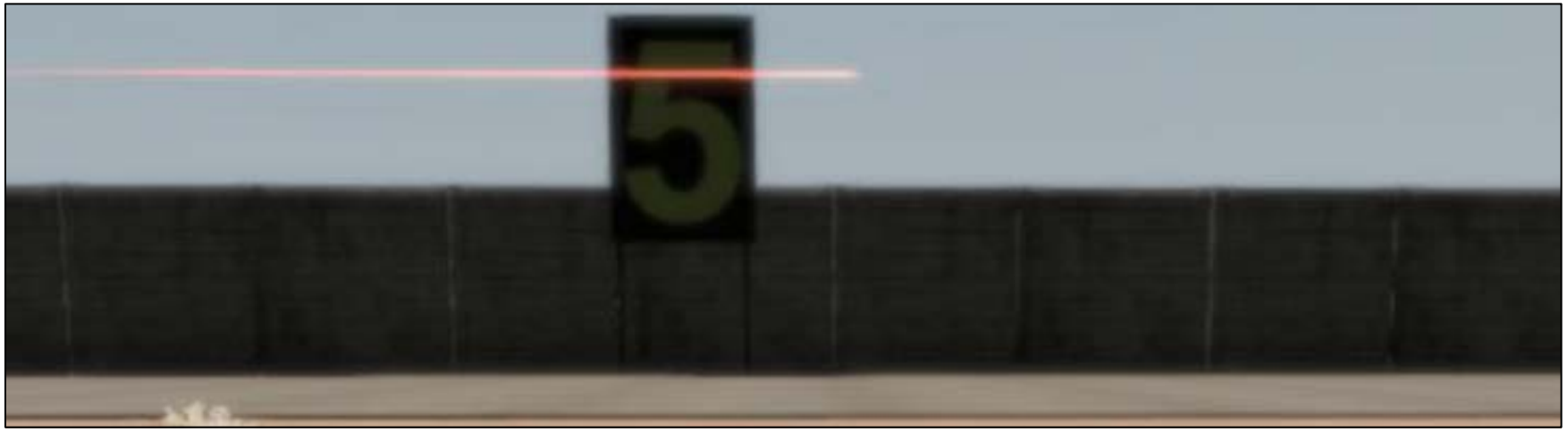
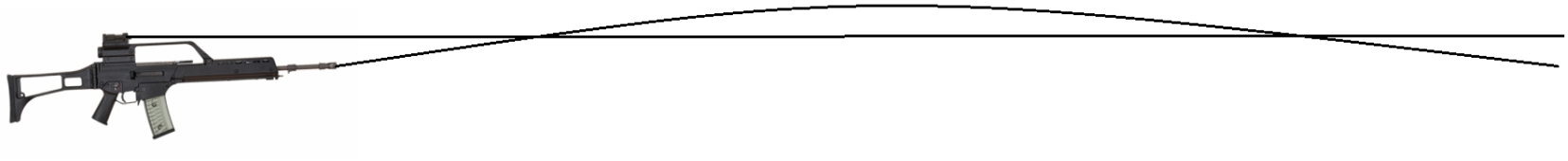
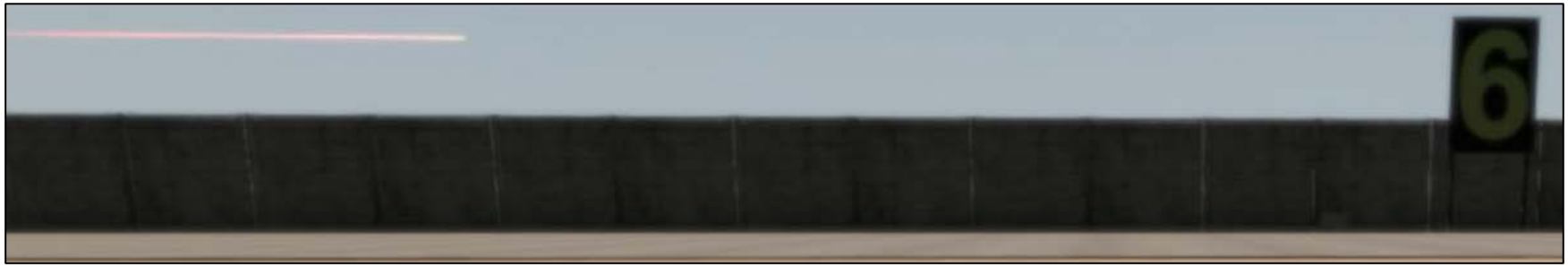
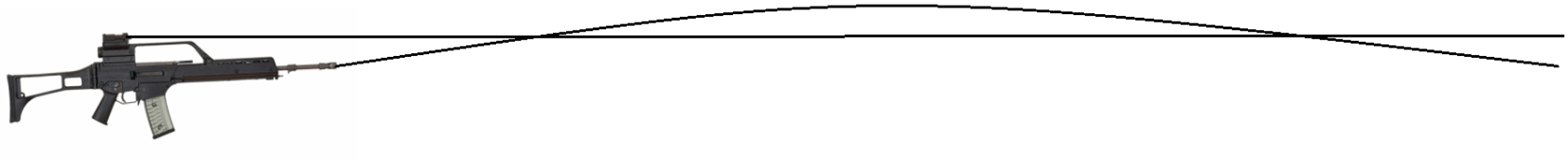


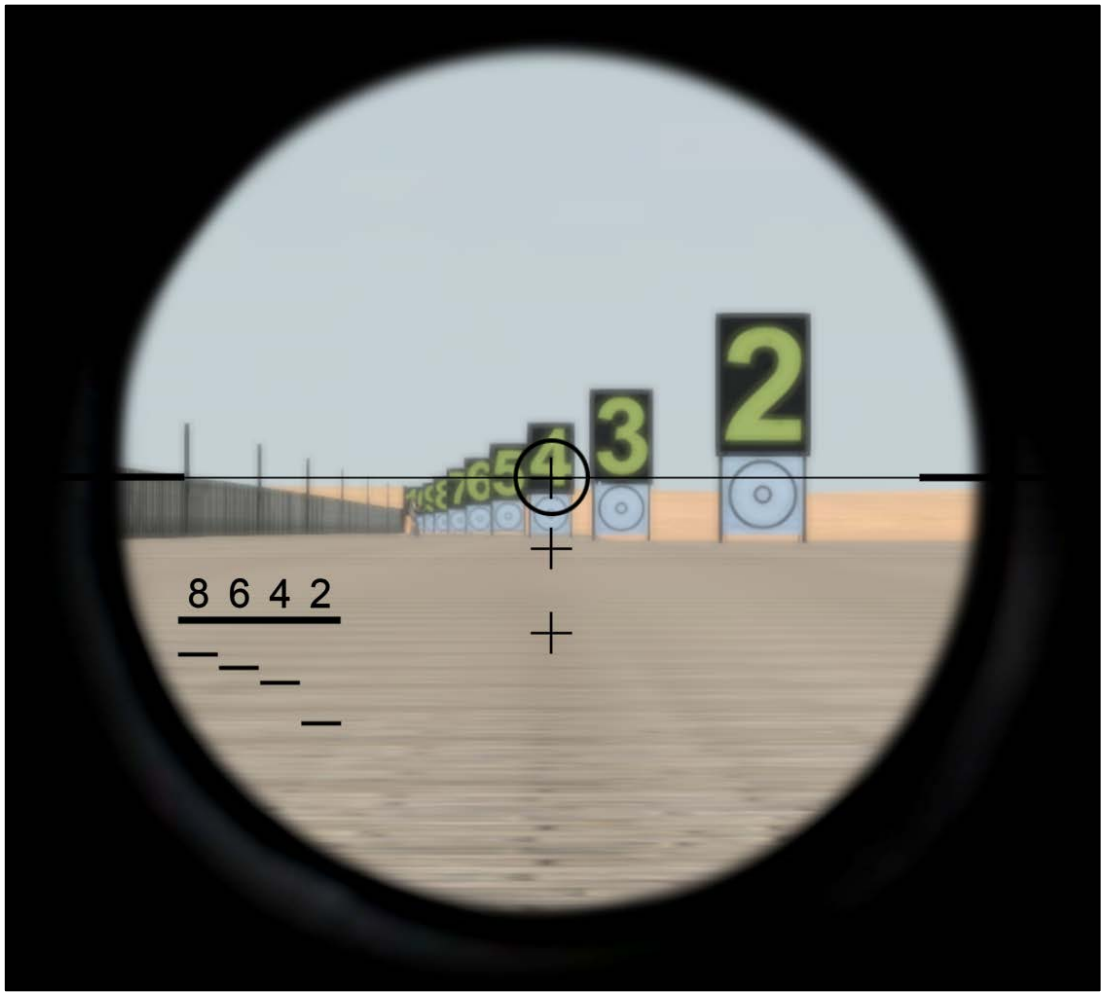


Experiment of **Weapons‘ Ballistics**

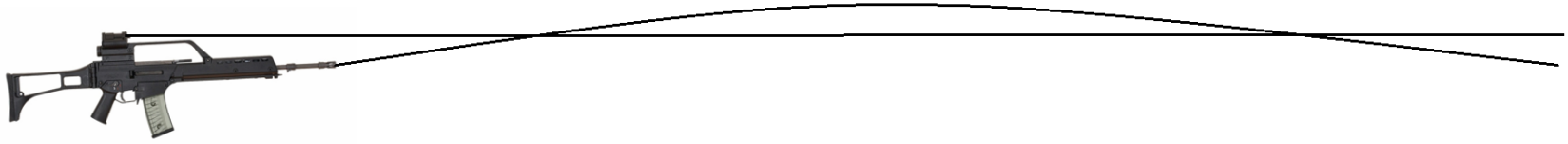


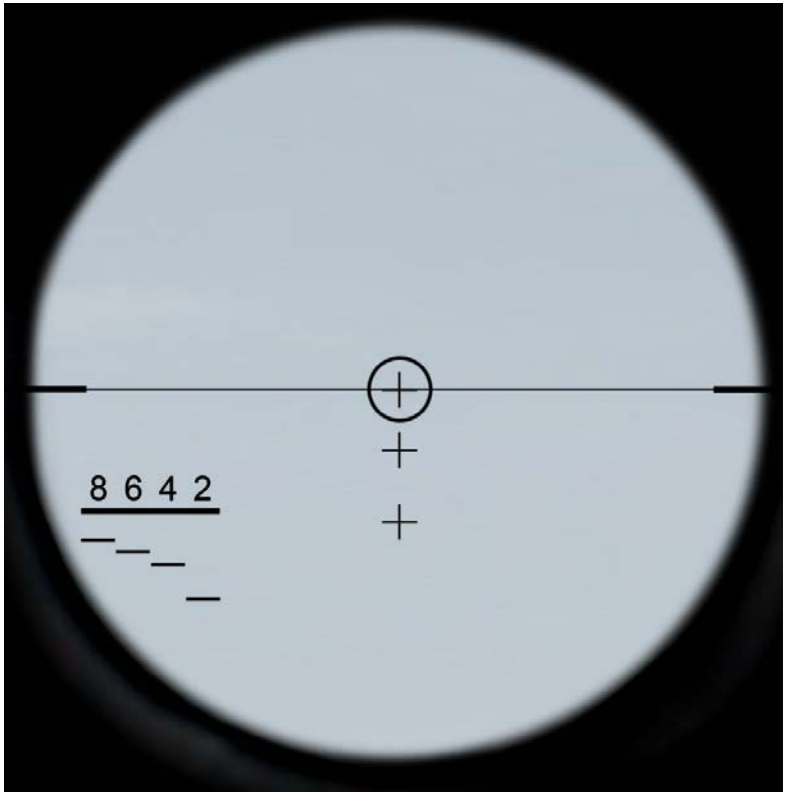


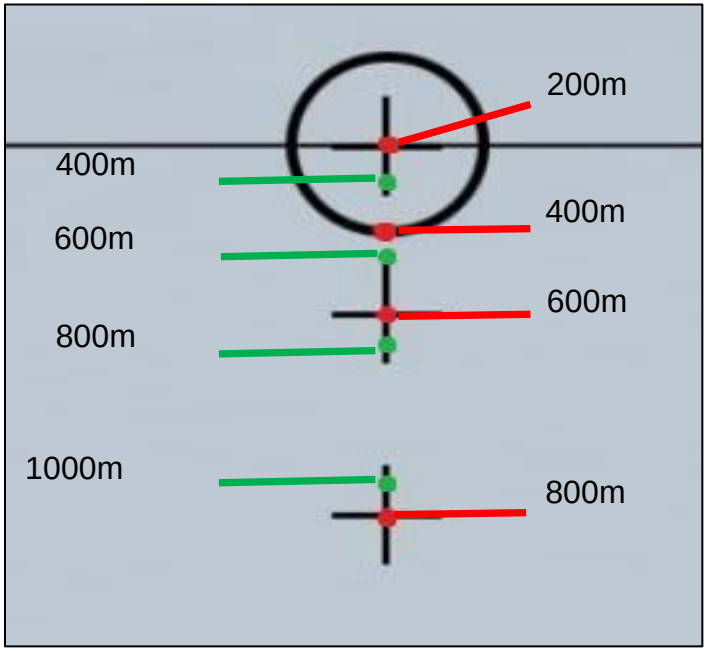
Experiment with **Telescopic Sight**



Experiment with **Telescopic Sight**







Experiment with **Reflector Sight**

5m

10m

15m

20m

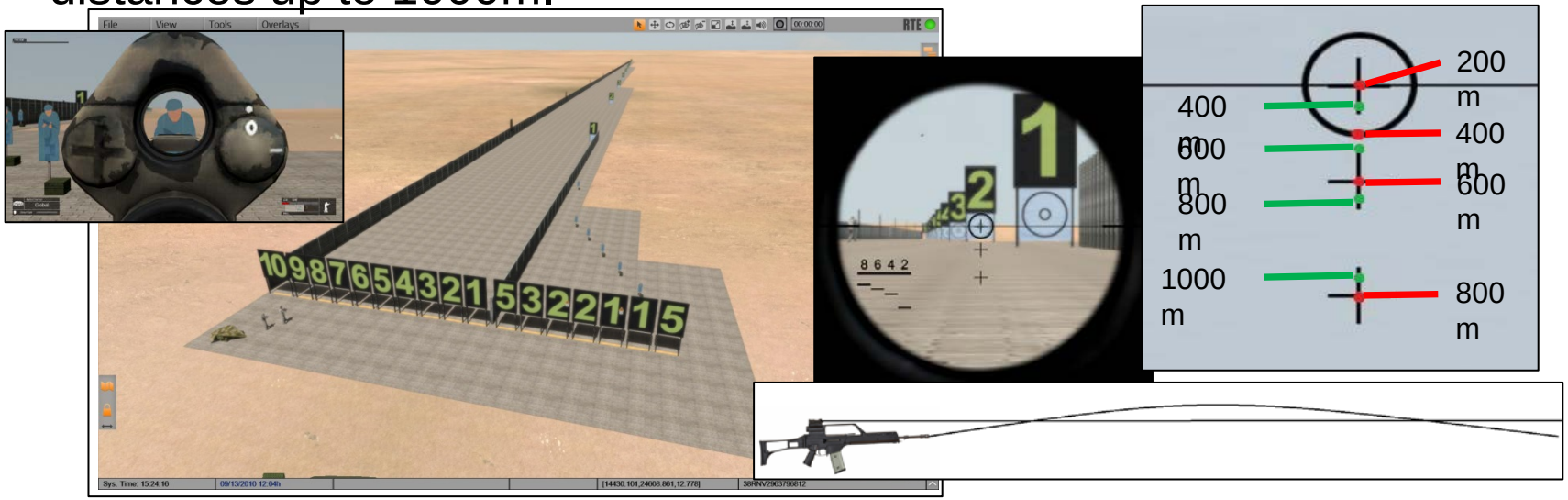
25m

30m

50m

Aim and Results of **Weapons** Study

- *Are the software's models of weapon ballistics conforming to expectations?*
- In focus we tested the **correctness** of **projectiles' flight paths** and if both sights (telescopic & reflector) of the H&K G36 are presented correctly. For doing so we built up a dedicated firing range for distances up to 1000m.



➔ Results: the weapon **ballistics model behaves accordingly to reality** (only exception: weather conditions (rain and wind) do not have any influence on the flight path), but the **H&K G36's telescopic sight** is slightly **off scale**

Summary of the **Study Results Team 1**

- **Complex software** interesting for many and diverse analysis

- **Involving** already a very large amount of **details**, but **maturity** of weapons', soldiers' and vehicles' models is quite **differing**

- **Creativity** is **necessary** while working with the software to **develop scenarios** and to **deal with** the **artificial intelligence**

Being aware of VBS3 ability powers and individual models' challenges, it can be used for scenario analysis!

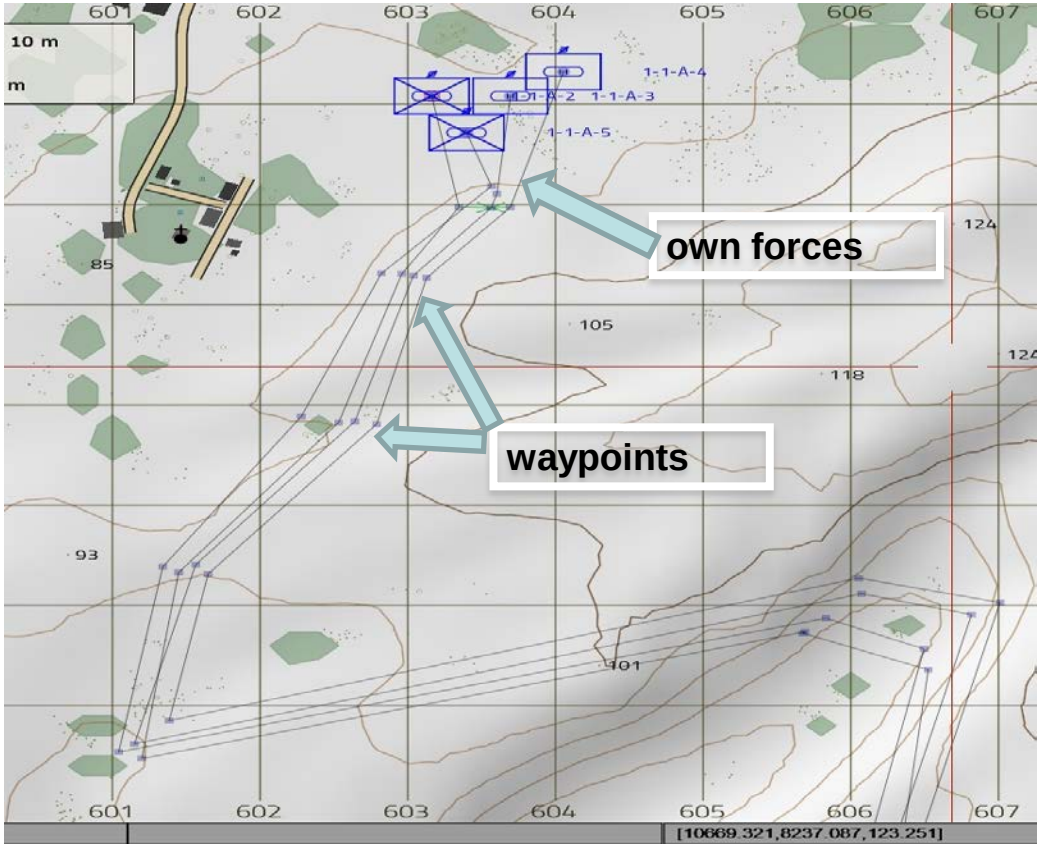
Team 2. Scenarios - Overview

- Analysis of terrain, weapons, vehicles:
  - Konstantin Klein: Creation of the harbour city Eckernförde
  - Enrico Barth: Light armored vehicles & convoys
  - **Jeanette Diesing: Tanks**
  - Lucas Pätzold: UAVs
  - Sabrina Güllich: Firearms and the reactions of others to their deployment
  - Lisa Hoffmann: EUNAVFOR MED – Operation Sophia (triggers)

- Artificial Intelligence:
  - **Alexander Mergel/Felix Bender: Setting up complex missions (fighting in a small village)**
  - Jan Rodewald: Fighting one vs. many
  - André Rahe: Battles of Encirclement and Annihilation

1 – Tanks (Jeanette Diesing)

- Own forces: mixed tank platoon (Bradley & Leopard 2A4)

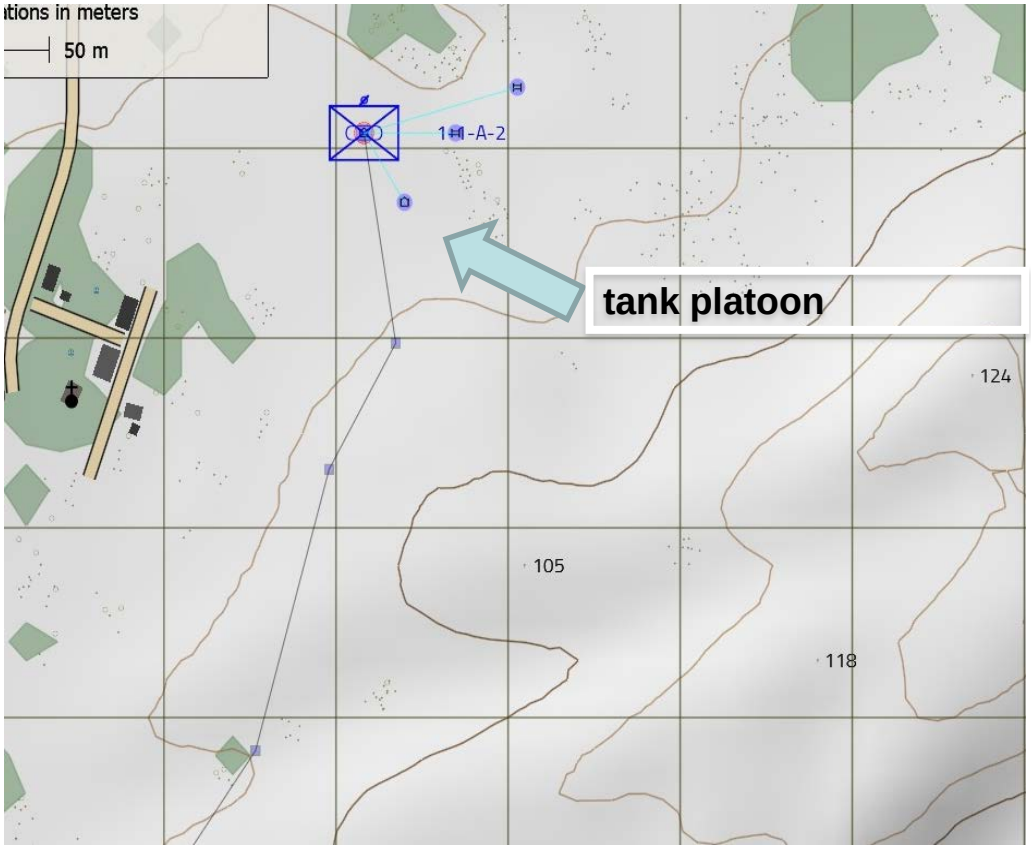


1 – Tanks (Jeanette Diesing)

- Self blocking

1 – Tanks (Jeanette Diesing)

- Combining own forces under one tactical symbol



1 – Tanks (Jeanette Diesing)

- Own forces at starting point

1 – Tanks (Jeanette Diesing)

- Driving on different terrain (streets, paths, cross-country)
- Realistic velocity (w.r.t. technical specification)
- Depending on the surface

- Collisions
  - Trees: rolled over
  - Camouflage net: no obstacle
  - Tents: too solid
  - S-twist: no obstacle
  - Cars: pushed
  - Concrete (<1m): stops tank

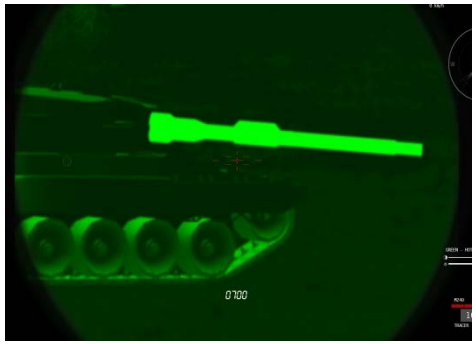
1 – Tanks (Jeanette Diesing)

- Artificial Intelligence:
  - Tactical behavior when reaching final waypoint (perimeter guarding)
  - Communication within the platoon
  - AI-controlled engagement
  - Enemy soldiers get off their tanks when being attacked
  - Own soldiers get off tank on command, **but never get on again**

1 – Tanks (Jeanette Diesing)

- Infrared (IR) optics:
  - Cool tank barely visible
  - Motor of moved tank visible
  - Muzzle after shooting visible
  - Enemy soldiers visible
  - Shoots on rocks visible
  - Can see through smoke
- IR optics behaves lifelike



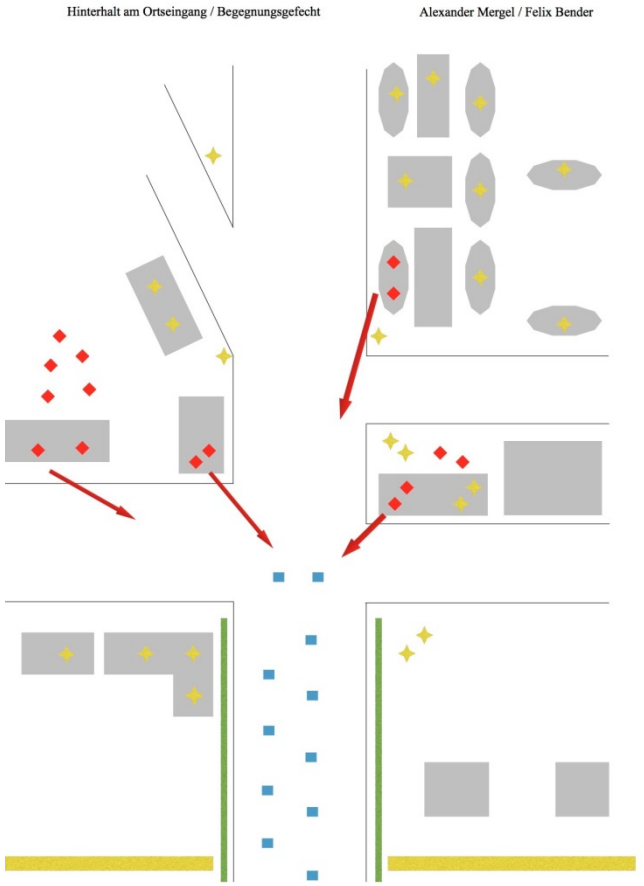


1 – Tanks (Jeanette Diesing)

- Weapons:
  - MK Bushmaster 25mm (Bradley)
    - Heavy development of smoke after a single shot
    - Reloading without time delay
    - **Commander cannot fire**
  - TOW
    - Impossible to move tank while TOW in flight
    - Reloading without time delay
    - No smoke visible when fired by enemy

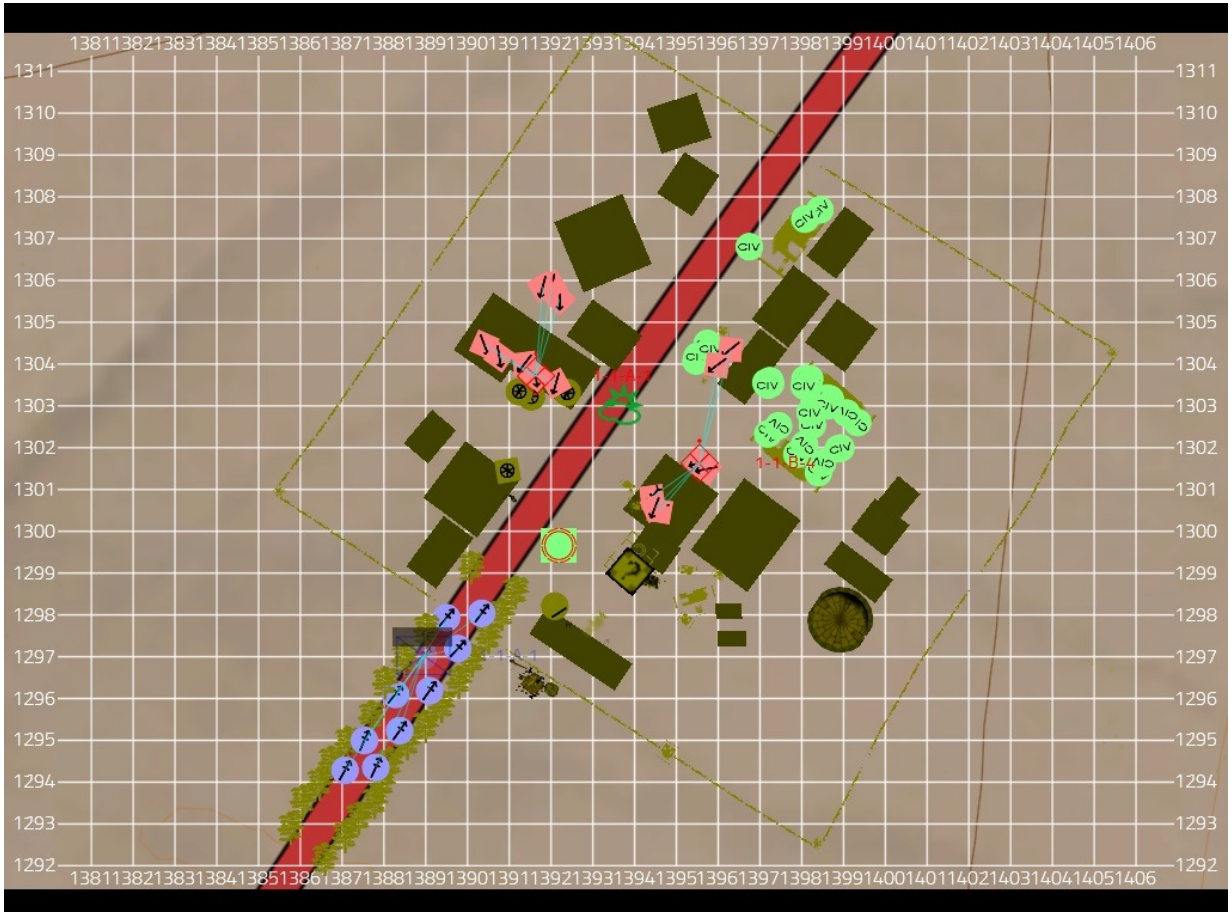
2 - Setting up complex missions (A. Mergel/F. Bender)

- Idea:
  - A village in a rural area
  - Group of soldiers attacked by insurgants from buildings (inside & rooftop)
  - Goal: fight against isurgants, protect civilians
- BLUE: 10 light infantry soldiers
- RED: insurgants
- YELLOW: civilians



2 - Setting up complex missions (A. Mergel/F. Bender)

- Placing humans (BLUEFOR, INS, CIV):



2 - Setting up complex missions (A. Mergel/F. Bender)

- AI behavior: coordinated vs. uncoordinated

2 - Setting up complex missions (A. Mergel/F. Bender)

- Statistics: victory/loss/termination, casualties, coordination (yes/no)

Lfd Nr	Sieg	Niederlage	Abbruch	Vernichtete Taliban	Verluste	Getötete Zivilisten	Koordinierte Gefechtsführung Taliban	Koordinierte Gefechtsführung BLUEFOR
1			X	9	9	5	☐	✓
2			X	5	5	2	☐	☐
3	X			15	4	1	✓	✓
4	X			15	3	2	☐	✓
5	X			15	3	2	☐	✓
6	X			15	9	0	✓	☐
7			X	10	6	0	☐	☐
8			X	13	7	0	☐	☐
9		X		6	10	0	✓	☐
10	X			15	5	1	☐	✓
11	X			15	3	0	☐	✓
12	X			15	2	1	☐	✓
13			X	11	7	1	✓	☐
14	X			15	3	3	☐	✓
15	X			15	4	0	✓	✓
16	X			15	6	0	☐	☐
17	X			15	7	2	☐	☐
18	X			15	1	0	☐	✓
19	X			15	4	0	☐	✓
20		X		11	10	2	✓	☐

2 - Setting up complex missions (A. Mergel/F. Bender)

- Average losses:
  - BLUEFOR loss: 5.28
  - INS loss: 13
  - CIV loss: 1.14
- Coordinated behavior:
  - BLUEFOR: 50%
  - INS: 42%
- Results:
  - BLUEFOR wins: 58%
  - INS wins: 16%
  - Terminated: 26%

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: Group leader does not move

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: Civilians get killed

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: Civilians seek cover

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: „Lone Ranger“

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: AI controlled player do not fire through (open) windows

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: MG-3 fired standing

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: AI selects weird security areas

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: „Spontaneous peacemaking“

2 - Setting up complex missions (A. Mergel/F. Bender)

- Observation: Graphic display bugs

Conclusions

- 15 students, 150 hours, no further training (10 hours for playing tutorials)
- Different levels of experience (from *novices* to *hardcore ego-shooter gamers*)
- In the end, all were enthusiastic: learning with and from simulations is a motivating topic
- Students were (**over?) critical** and took very close look on details
- Some physical and technical effects were surprisingly well covered, others are too coarse to be considered realistic or lifelike
- VBS has its merrits for training soldiers
- VBS should not be used for decision analysis/analytical simulations without a human-in-the-loop, because AI does not work reliable enough