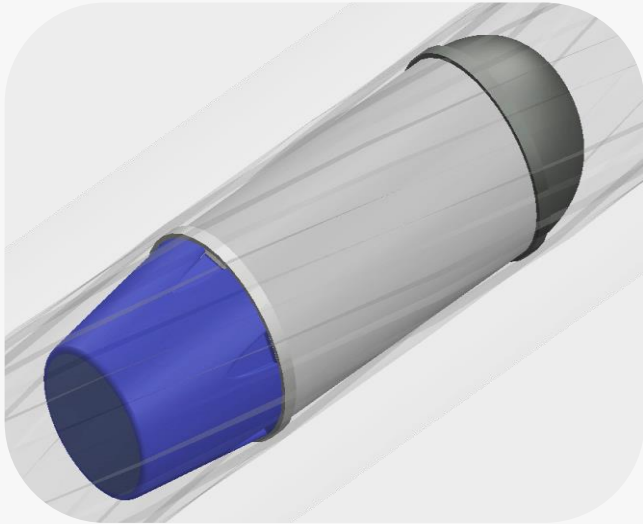




**TÉCNICO**  
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# The FIREND Project

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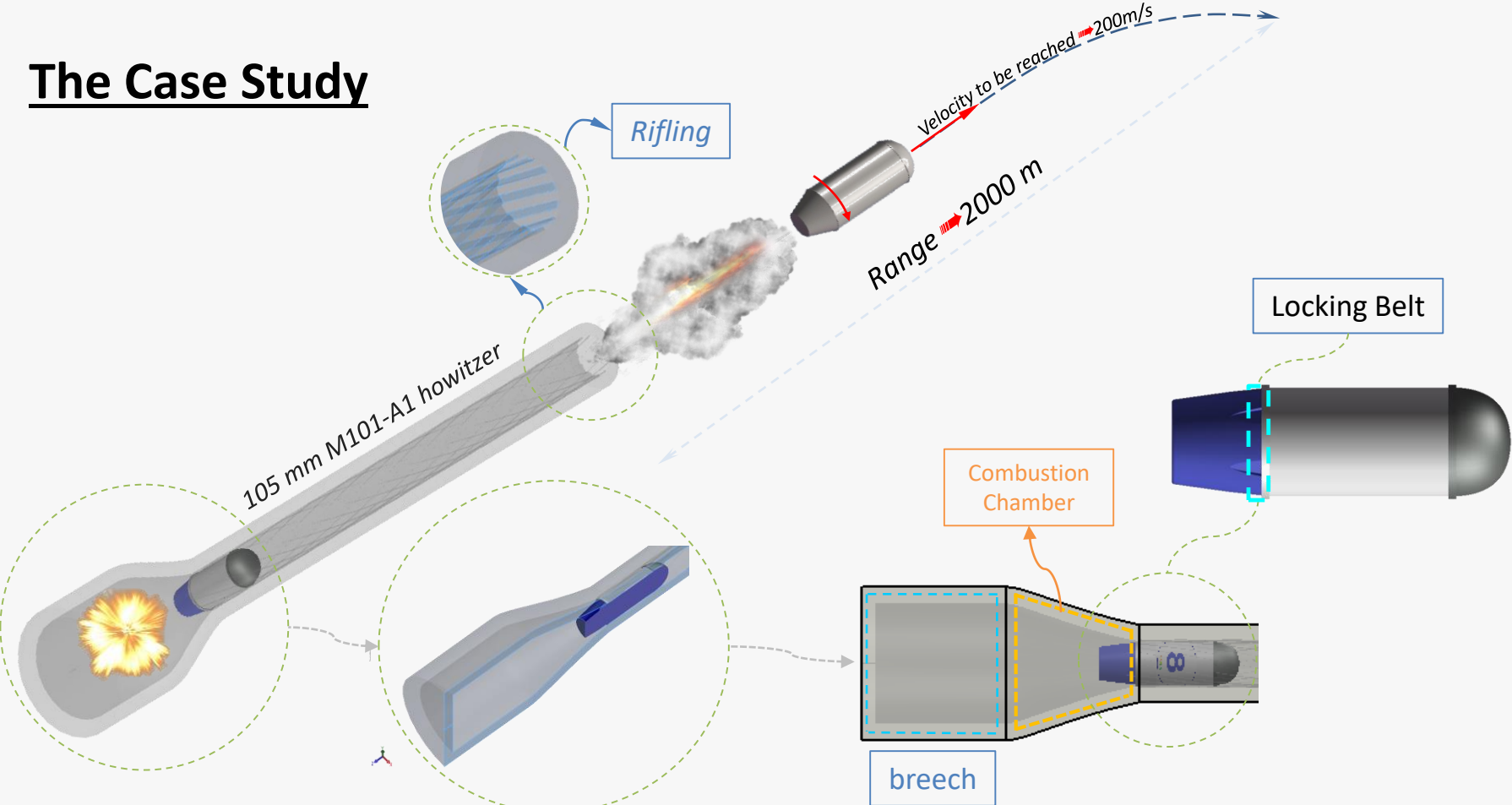
Supervisor: Prof. Edgar Caetano Fernandes

20<sup>th</sup> September, 2019

# Objectives

- ✓ Mathematically model the interior ballistics
- ✓ Adding the influence of the grain perforations into the model
- ✓ Considering the influence of the resisting forces: **Rifling**, **Friction**, and **Air resistance**
- ✓ Considering the influence of the locking belt
- ✓ Validation of the results from mathematical model
- ✓ Defining the exact **type** and the **amount** of propellant to reach **200 m/s** of the muzzle velocity

# The Case Study



# Experimental Results

Test Number	Projectile Weight (g)	Propellant Composition	Measured Range (m)	Projectile Speed (m/s)	Rotational Speed (rpm)
1	2305	240g P <sub>7</sub>	247	76,67	1896,63
2	2297	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	420	120,48	3916,96
3	2301	240g P <sub>7</sub>	296	93,70	2860,00
4	2282	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	296	93,70	2815,32
5	2320	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	370	84,33	2434,87
6	2305	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	107	73,33	2047,50
7	2293	240g P <sub>7</sub> + 48 g <sub>gunpowder</sub>	495	129,74	3916,96
8	2292	240g P <sub>7</sub> + 48 g <sub>gunpowder</sub>	470	105,42	2815,32
9	2319	240g P <sub>7</sub> + 48 g <sub>gunpowder</sub>	570	120,48	3833,62
10	2324	240g P <sub>7</sub> + 48 g <sub>gunpowder</sub>	570	129,74	4004,00
11	2320	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	420	105,42	3003,00
12	2326	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	296	99,22	3106,55
13	2325	240g P <sub>7</sub> + 24 g <sub>gunpowder</sub>	470	93,70	2906,13
14	2329	240g P <sub>7</sub> + 72 g <sub>gunpowder</sub>	620	140,56	4504,50
15	2312	300g P <sub>7</sub> + 60 g <sub>gunpowder</sub>	570	160,63	4869,73
16	2206	300g P <sub>7</sub> + 60 g <sub>gunpowder</sub>	620	153,33	4869,73
17	2328	400g P <sub>7</sub> + 80 g <sub>gunpowder</sub>	100	168,67	5148,01

# Numerical Analysis

Propellant: Gun Powder (80g)

## RESULTS OF THERMOCHEMICAL CALCULATION:

### Combustion condition:

Loading density = 0.032 g/cm<sup>3</sup>

**Propellant:** Gun Powder

Potassium nitrate (KNO<sub>3</sub>), 75 %

Charcoal, 15 %

Sulphur (S), 10 %

**C** (0.898) **H** (0.622) **N** (0.616) **O** (1.914) **K** (0.616) **S** (0.259)

Molecular weight = 83.07 g/mol

### Combustion parameters :

- Adiabatic combustion temperature = 2239.0 K
- Pressure in closed vessel = 10.552 MPa
- Force or 'specific energy (F = nRT) = 0.32014 MJ/kg
- Covolume of gaseous products = 0.681 cm<sup>3</sup>/g
- Specific heat ratio (C<sub>p</sub>/C<sub>v</sub>) = 1.1130

