Investigation of thermal protection systems for hybrid rocket motors

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INTRODUCTION

- **Introduction**
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- **CISAS knowledge**

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  - Why is it innovative?
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**Introduction - Hybrid Rocket Motors**

- **Oxidizer** stored liquid in the tank
- **Fuel** stored solid in the combustion chamber
- One controllable feeding line
- Different technological solutions and propellant formulations

**Main characteristics**

**Advantages**
- Safety
- Low costs
- Simplicity
- Green propellants
- Oxidizer flow control → Mission abort and throttability

**Disadvantages**
- Low regression rates → Low volumetric efficiency
- Combustion efficiency
- High oxygen content in the exhaust
Introduction

➢ Hybrid rocket motors

CISAS knowledge

Phd project

➢ Why is it innovative?
➢ Methods of analysis
CISAS Knowledge

✓ Equipped test facility
✓ Great experience with hybrid rocket motors
✓ Use of HTP as liquid oxidizer
✓ High combustion efficiency
✓ Different scale motors: from 1 up to 10 KN
✓ Throttleable motors
Phd project

Introduction
- Hybrid rocket motors

CISAS knowledge

Phd project
- Why is it innovative?
- Methods of analysis
Limit of the current technology:
impossibility to maintain high performances for a long time
burn firing because of the excessive consumption of the actual materials

The design of new thermal protection systems is needed
Ablative materials are already widely used in solid rocket motors, but there are many differences with hybrid rocket motors:

- Higher level of oxygen
- Lower pressure
- Lower temperature
- Must be cheap
- Possibly suitable also for a restart of the motor

Poor literature about this topic...
Methods of analysis

CFD

FEM

Total Temperature

Contour 3

2.82ε+003
2.708ε+003
2.488ε+003
2.467ε+003
2.347ε+003
2.228ε+003
2.10ε+003
1.985ε+003
1.86ε+003
1.744ε+003
1.623ε+003
1.503ε+003
1.382ε+003
1.262ε+003
1.141ε+003
1.021ε+003
9.000ε+002

[K]
Methods of analysis

FIRE TESTS
Thank you for your time! Any questions?