Design of a European Hyperloop Large Scale Technology and Research Infrastructure

- The nub of Hyperloop
- LSRI - Lathen TVE
- HYPERION Framework
- Best practise approach

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**Hyperloop - the nub of the matter**

\[
F_D = \frac{1}{2} \rho C_D A \cdot v^2
\]

\[
P_D = F_D \cdot v
= \frac{1}{2} \rho C_D A \cdot v^3
\]

\[v > 400 \ km/h \Rightarrow E_{loss} > 83\% \quad \text{due to air friction}\]
Hyperloop evolution

\[ v_{\text{max}} = 603 \text{ km/h} \]

Shinkansen L0 (jap. 新幹線L0系電車)

Supersonic, i.e. \( v_{\text{max}} > 1080 \text{ km/h} \)

Hyperloop Tube Transport

https://www.youtube.com/watch?v=ElUEST-s1Wg

https://zeleros.com/hyperloop-center-spain-europe/
Challenges for EU Hyperloop

- Superstructure and Civil Engineering
- Low pressure environment
- Fluid dynamics
- Propulsion & braking
- Levitation & suspension
- Guidance & switching
- Pod motion physics
- Power generation & supply
- Airlocks & transfer
- Environmental control & life support systems (ECLSS)
- Network communication & control systems
- Safety & emergency management
- ...
Lathen - the cradle of EU Hyperloop

//en.wikipedia.org/wiki/Emsland_test_facility
R&D fields

Facilities at LSRI - HUB

- Full scale superstructure and tube
- Modular compartments
- Power supply
- Vacuum equipment and handling
- Network, control systems, and communication
- Environmental control & life support

Research & Development - Satellites

- Propulsion & braking
- Levitation and guiding
- Vehicle & pod motion physics
- Switching technologies
- Fluid dynamics
- Thermodynamics & energy dissipation
- Control systems, operations and approval
- ...

Prof. Dr. rer. nat. Walter Neu - IHT
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Tube technology

- Civil engineering
- Superstructure
  - Concrete tube
  - Steel tube
  - Composite materials
- Design & evaluation
  - Track segments
  - Loading
  - Expansion
  - Real life conditions
Vacuum technology

- Size and volume
- Vacuum pump technology
  - Volume rate
  - Leakage rate
  - Maintenance
- Airlock and valve design
- Thermodynamics and heat dissipation
- Fluid dynamics + shocks
MagLev technology

• Competing Technology
  • Electromagnetic Suspension
  • Electrodynamic Suspension
  • Superconductor Magnetic Suspension

• Research evaluation
  • Magnetic drag
  • Stability
  • Power consumption
  • High-Speed switch
Hub & Satellites

• Hub:
  • LSRI at Lathen, Germany
Hub & Satellites

• Hub:
  • LSRI at Lathen, Germany

• Satellites
  • EHC - Groningen, Netherlands
  • EuroTube - Valais, Switzerland
  • Hardt - Delft, Netherlands
  • HTT - Toulouse, France
  • Nevomo - Warsaw, Poland
  • TransPod - Droux, France
  • TUM - München, Germany
  • Virgin Hyperloop - Spain
  • Zeleros - Valencia, Spain
HYPERION Framework

- LSRI - Open Network
  - Hubs and Satellites
  - Cross domain research
  - Design of a novel data sharing infrastructure

- Users / Stakeholders
  - Academia / Universities
  - Industry, SMEs
  - Public stakeholders
  - EU platforms and projects
  - Standardization + Certification
HYPERION Framework

HYPERION strives for a radical new paradigm and technology on high-speed transportation which will be developed within a Pan-European context from the very beginning, therefore bypassing the traditional problems of technologies derived of national developments such as the non-yet interoperable European railways systems. The innovation setup of HYPERION in terms of high-speed infrastructure relies on having a European-wide system without interoperability barriers, very focussed in the business cases point-to-point, with a European dimension and therefore without the traditional national-devoted vision of the HSR.

Looking at a selection of research facilities in Europe and globally it becomes evident that only few facilities are in operation with various large-scale activities being planned outside of Europe (Table 4). However, none are capable of fully delivering the necessary environment for Hyperloop research to be performed for real-life application. The design study therefore caters to the need to establish a large-scale full-scale Hyperloop research facility within the high-speed technology sector. Thus, the design study would support a European endeavour to keep up with the technological development globally and establish an innovative research facility which is currently not present at any place globally.

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Best practice approach
Lathen - the cradle of EU Hyperloop
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ONE MORE THING ...

The IHT has openings to be filled as of now

2 PhD positions
Artificial Intelligence & Optimization of Logistics Tools

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