

Bionic Lightweight Design

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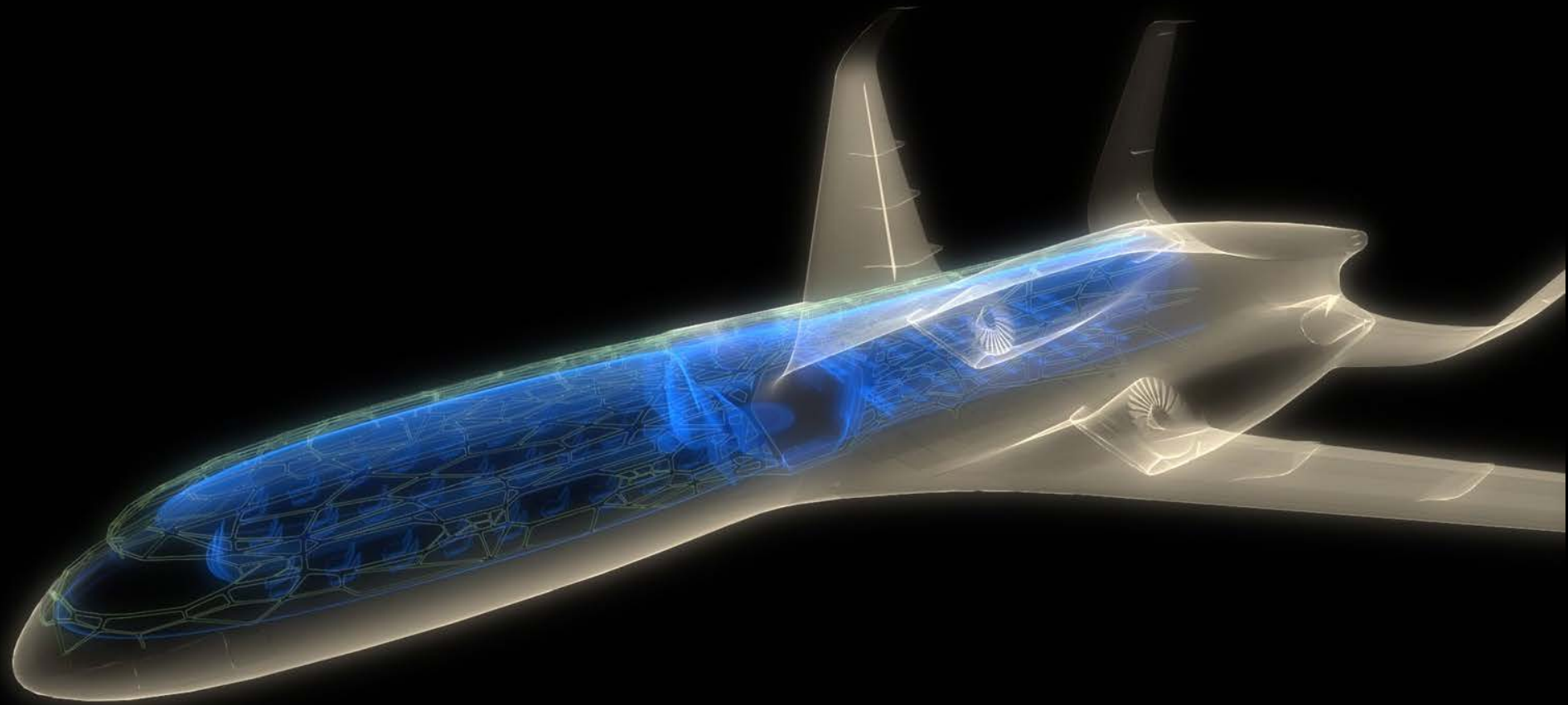
10th, International CFK-Valley Stade Convention
15–16 June 2016, STADEUM Stade (Germany)

 **ELiSE**
LEICHTBAU

 **PUMACY**
TECHNOLOGIES

 **AWI** ALFRED-WEGENER-INSTITUT
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UND MEERESFORSCHUNG

What is bionics / biomimetics? (Airbus Concept Plane)



Biomimetics: Just three steps!

LEARNING FROM NATURE



Recognition

Translation

Implementation

Biomimetics: Just three steps*

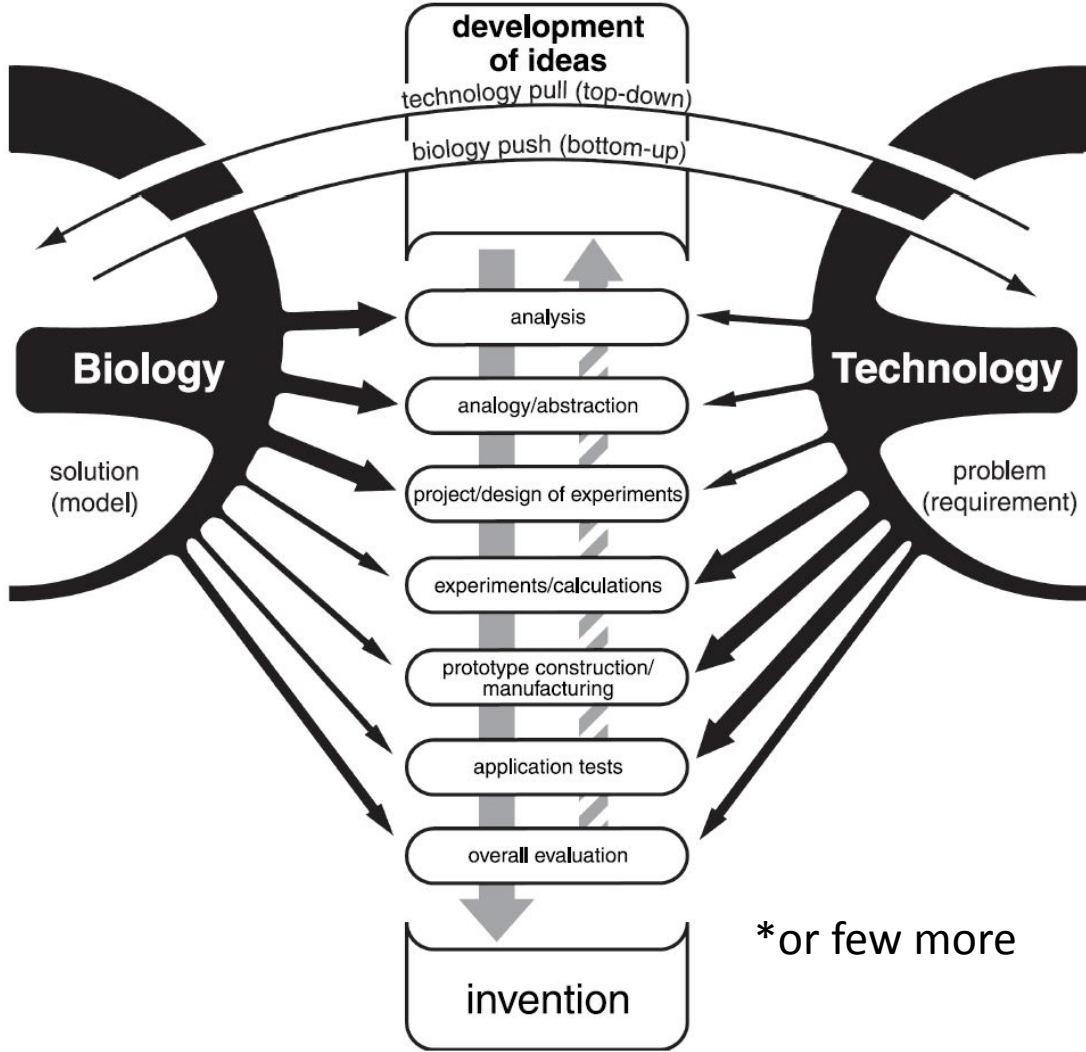


Figure 3. Simplified flow chart of a bionic development process (source: Fraunhofer UMSICHT/B/OKON, 2010)

Terminology and Methodology: ISO/DIS 18458
Biomimetic Optimization: ISO/DIS 18459

Biomimetics – Simple? (Biomimetic Bucket)



Biomimetics – the Future! (Airbus Bionic Partition)

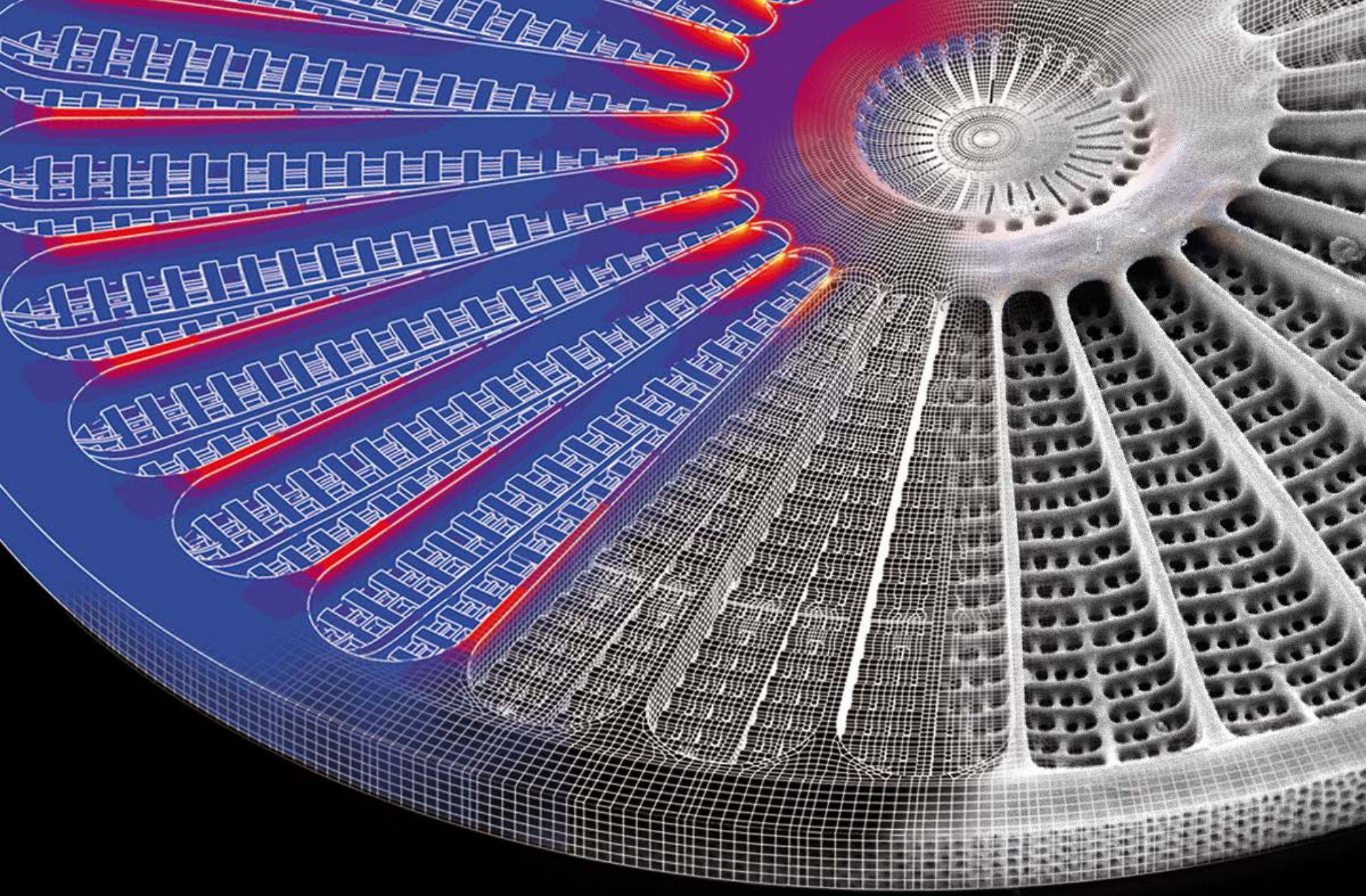


WE ARE USING

BIOLOGICAL INTELLIGENCE...

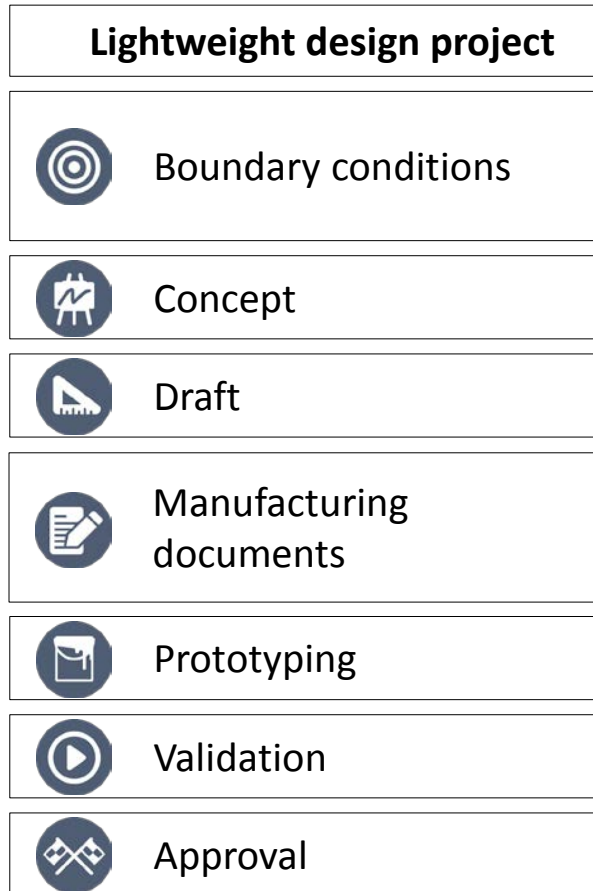
BIOLOGICAL ANALYSIS

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...
...
...
...



How can we systematically transfer lightweight solutions from nature to technical lightweight designs?

State of the art approach in technique



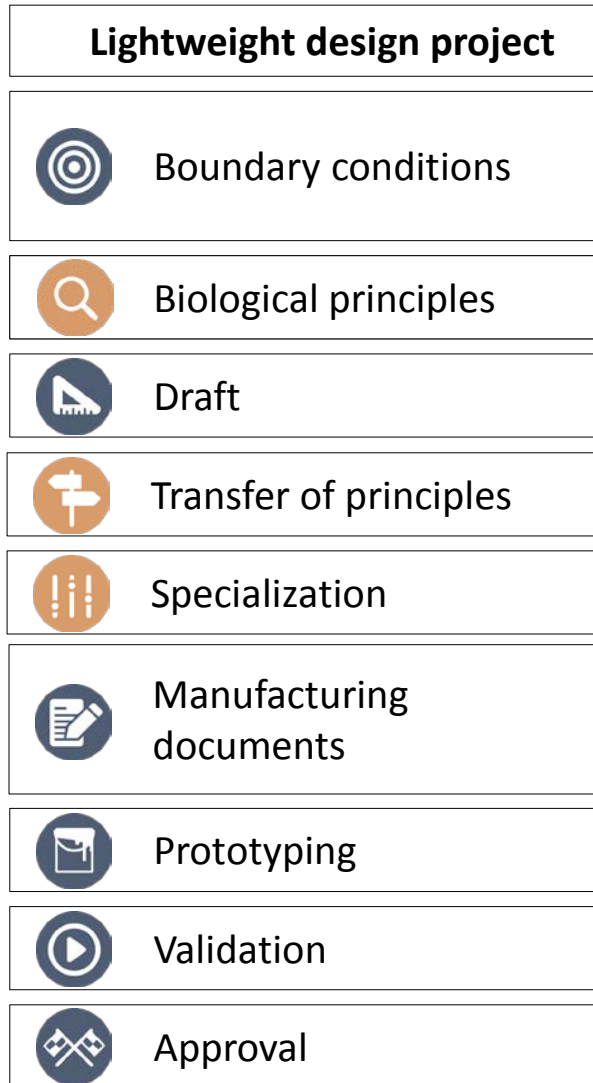
Systematic lightweight design process (Klein, 2001)

Problem

- Expert knowledge
- Improvements of existing solutions
- Only one concept
- Small innovation, no revolution

Goal: Systematic learning from nature

Systematic bionic lightweight design process



Concepts based on mechanical principles of nature

**Understanding the principles of nature
Transfer to engineering**

Functional similarity search

Lightweight design project



Boundary conditions



Biological principles



Draft



Transfer of principles



Specialization



Manufacturing documents



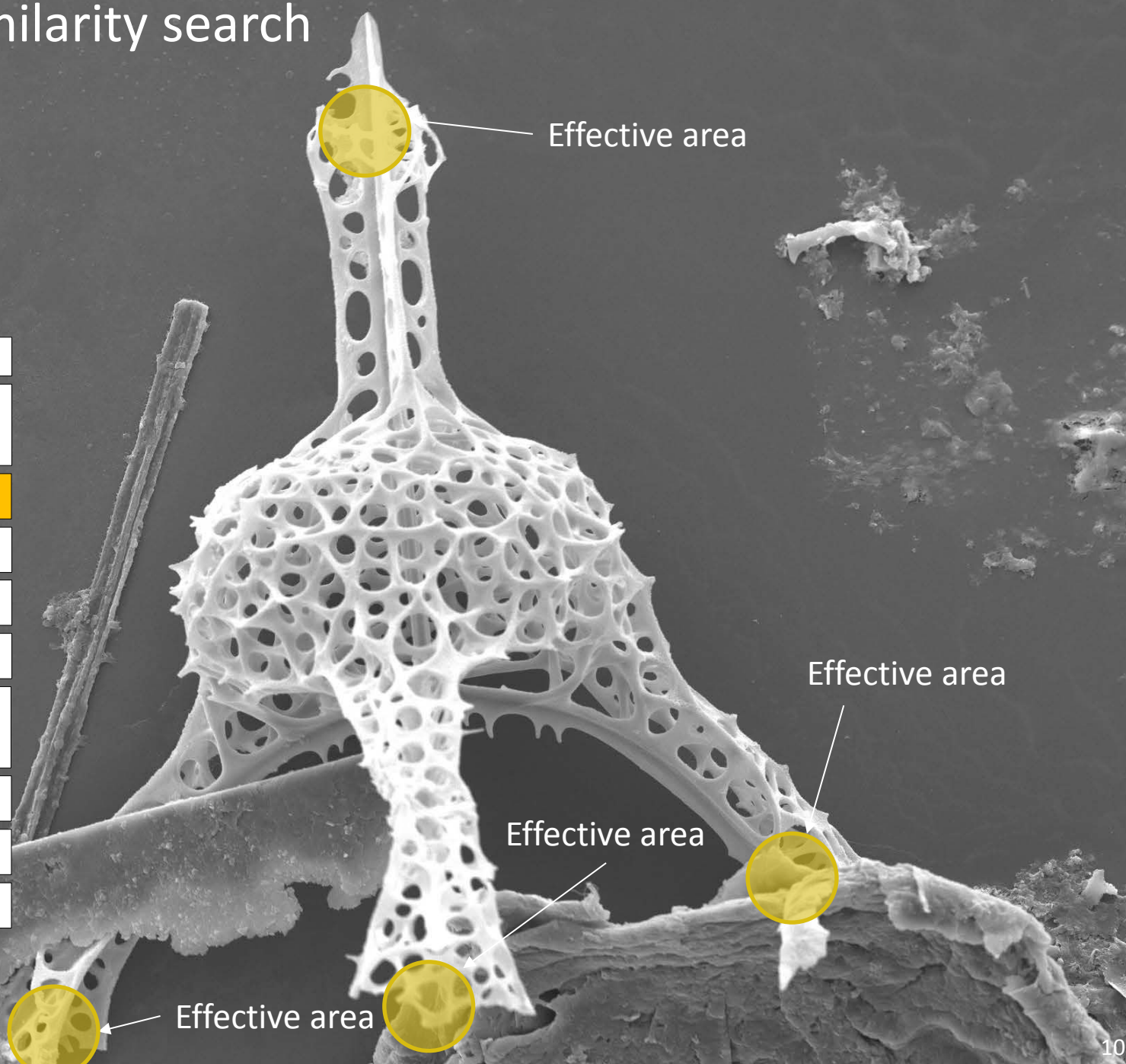
Prototyping



Validation



Approval



Effective area

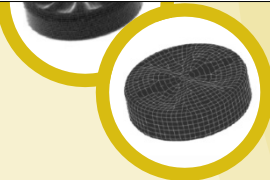
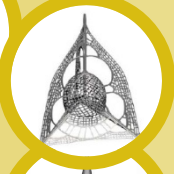
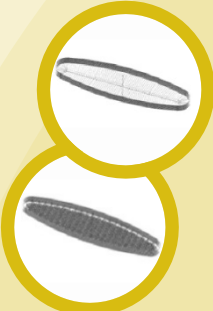
Effective area

Effective area

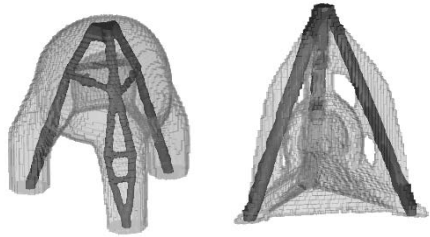
Effective area

Suitable biological archetypes

- Lightweight design project**
- Boundary conditions
- Biological principles**
- Draft
- Transfer of principles
- Specialization
- Manufacturing documents
- Prototyping
- Validation
- Approval



Transfer of biological principles



Lightweight design project



Boundary conditions



Biological principles



Draft



Transfer of principles



Specialization



Manufacturing documents



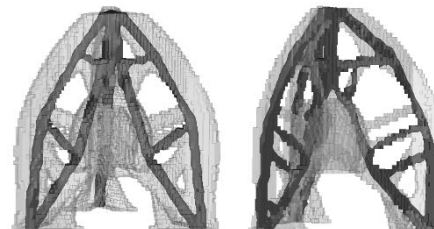
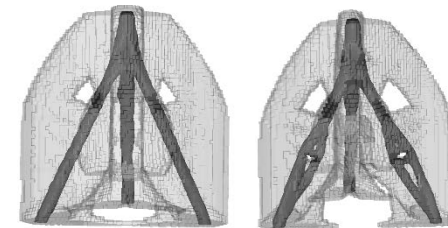
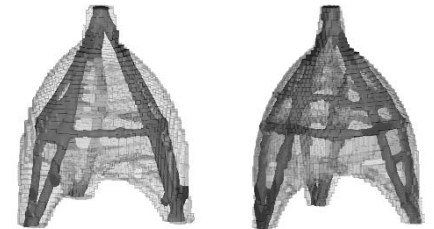
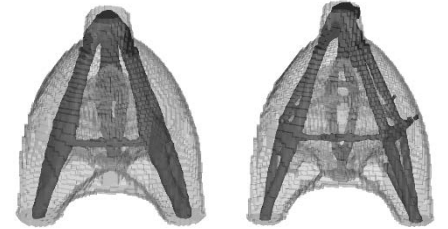
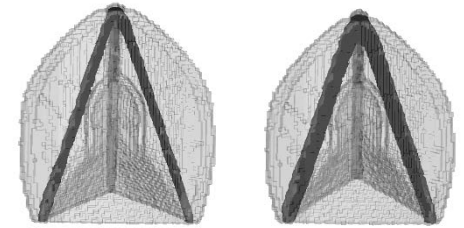
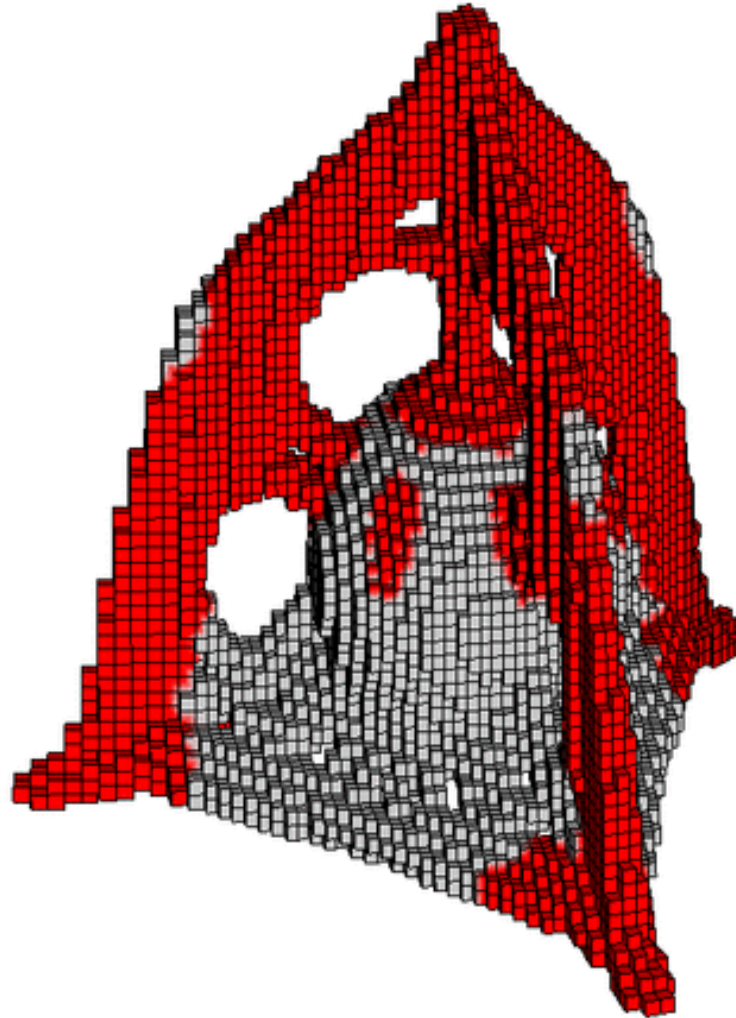
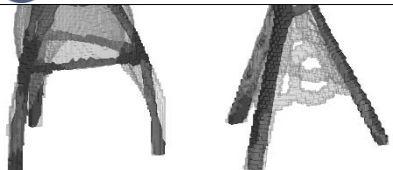
Prototyping



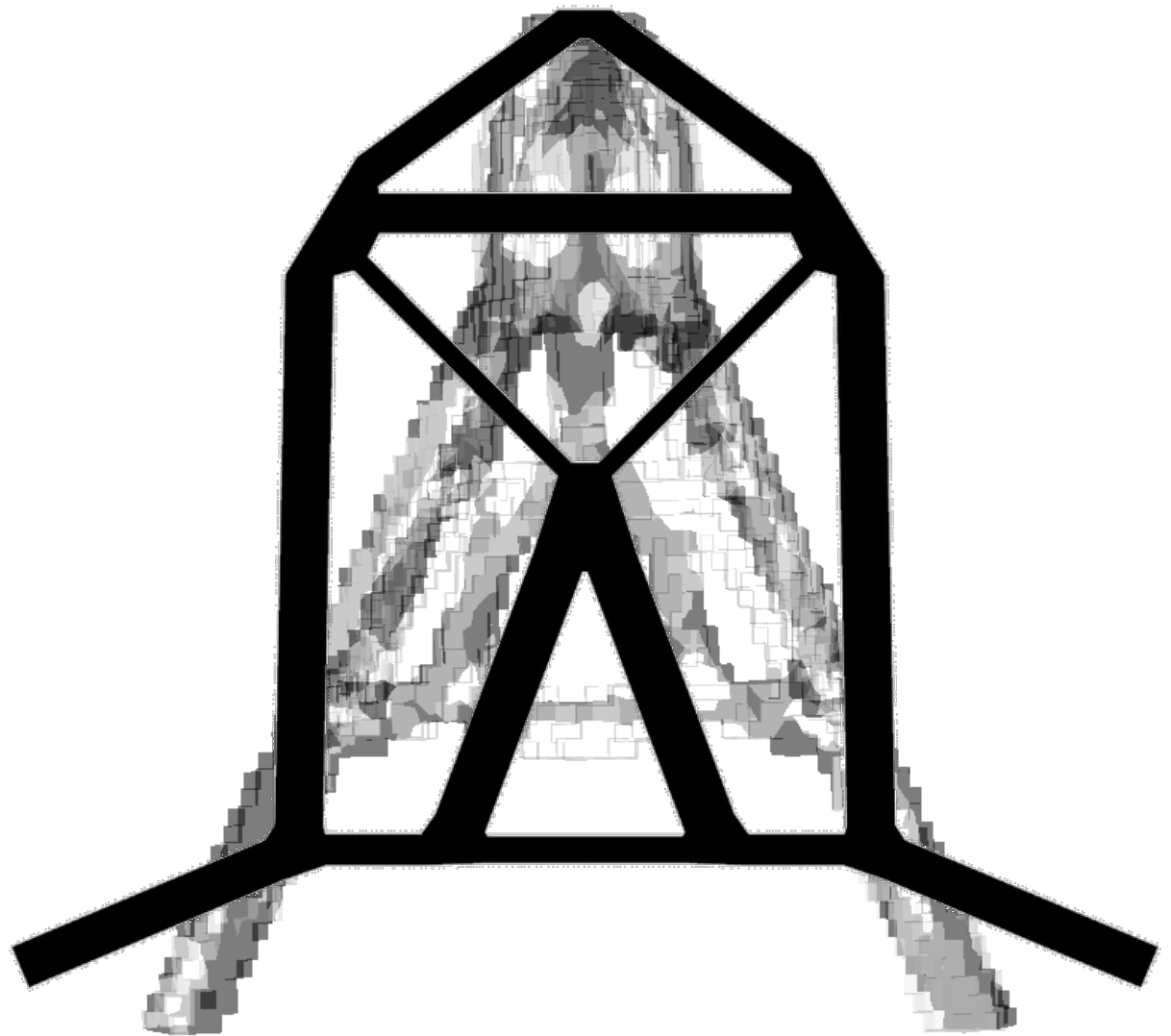
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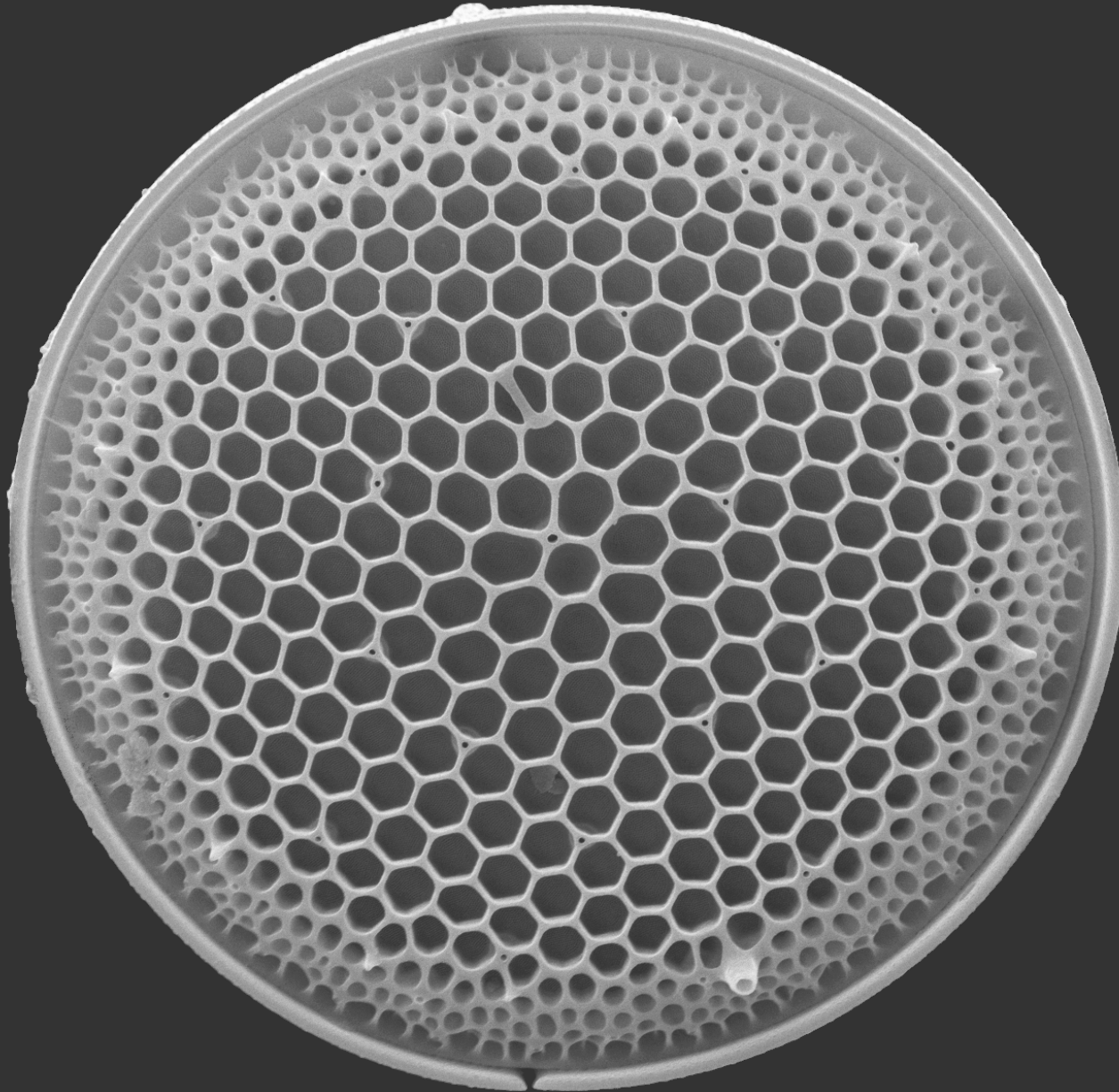


Approval

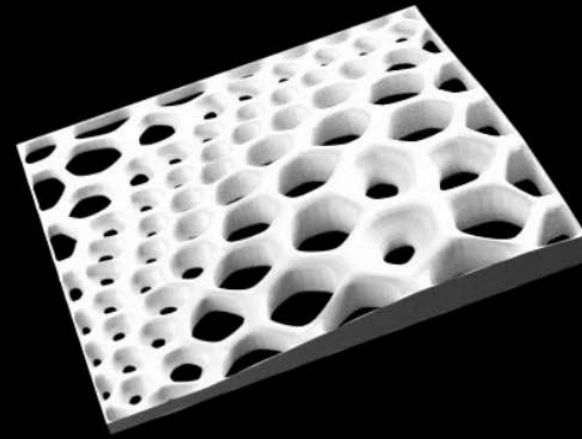
Bionic offshore foundation

- 
- › Weight reduction: **48%**
 - › Cost reduction: **300.000 €** per foundation
 - › Use of standard pipes
 - › Efficient transport saves logistic costs

Bionic surface reinforcements



Bionic algorithms for surface reinforcements



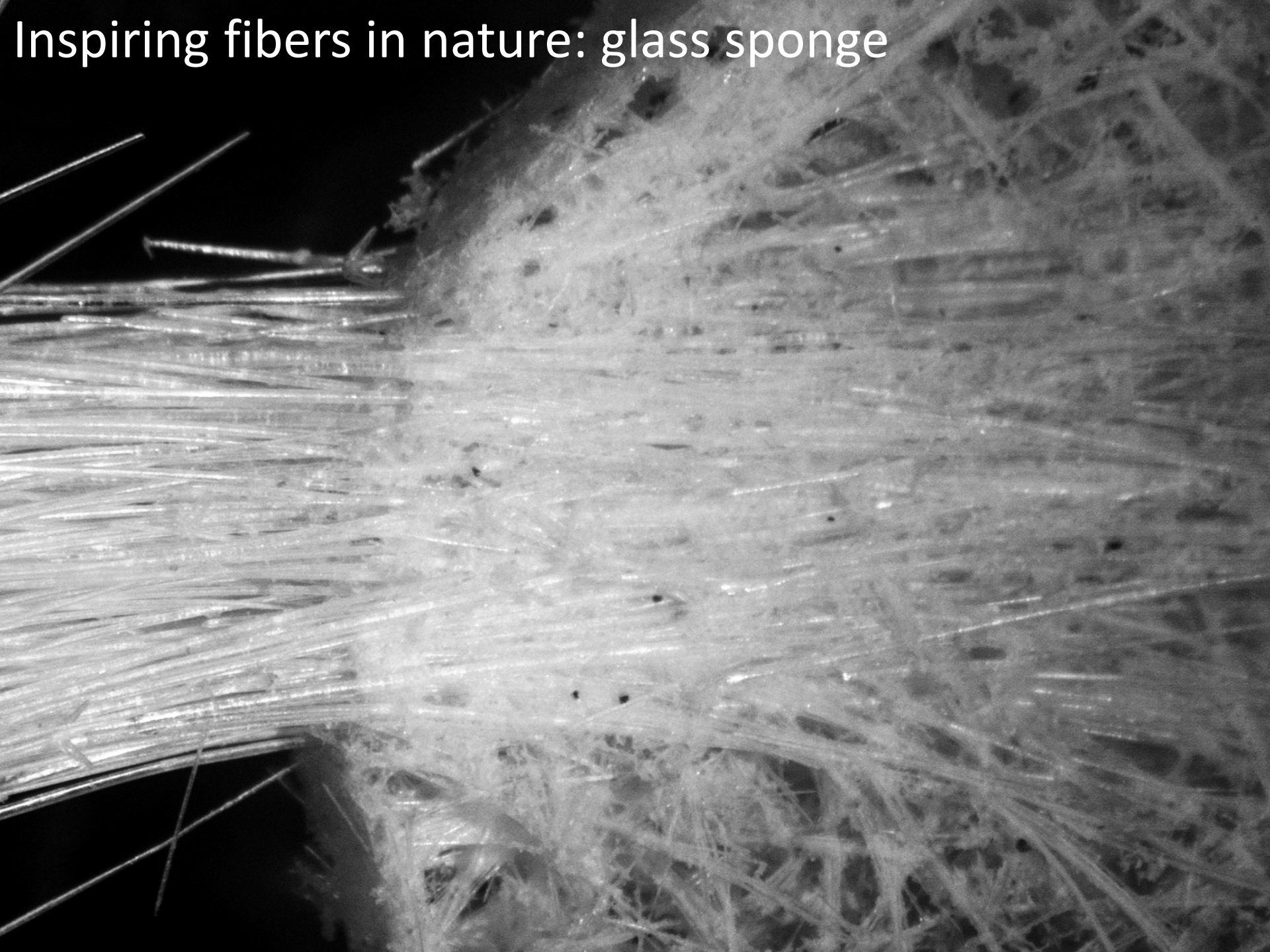
ifications

FEA analysis
&
Topology
optimization

ELiSE-Screening

Bio-inspired
surfaces &
volumes

Inspiring fibers in nature: glass sponge



Danke. Thanks. 감사합니다.

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