

# Master Thesis Proposals



**POLITECNICO**  
MILANO 1863

Federica Buccino: [federica.buccino@polimi.it](mailto:federica.buccino@polimi.it)

Sara Bagherifard: [sara.bagherifard@polimi.it](mailto:sara.bagherifard@polimi.it)

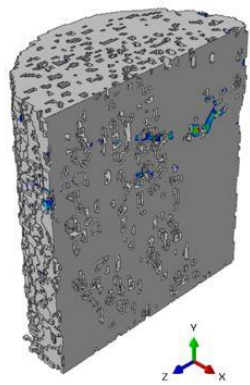
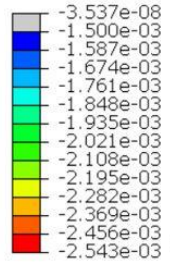
Laura Vergani: [laura.vergani@polimi.it](mailto:laura.vergani@polimi.it)



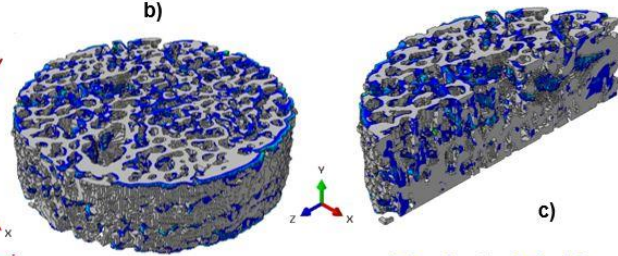
# Project mdAM: multi-scale disease by means of Additive Manufacturing

Additive Manufacturing Technology to study the effect of biological multi-scale voids

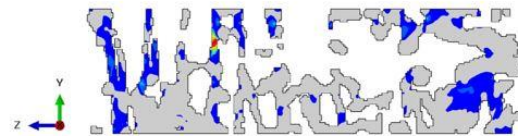
E, Min. Principal  
(Avg: 75%)



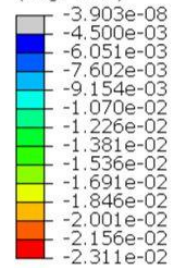
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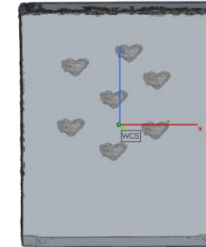
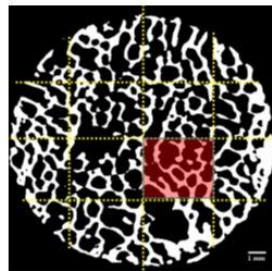
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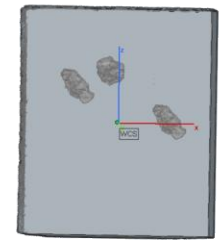
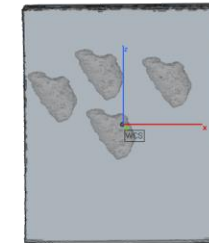
E, Min. Principal  
(Avg: 75%)



d)

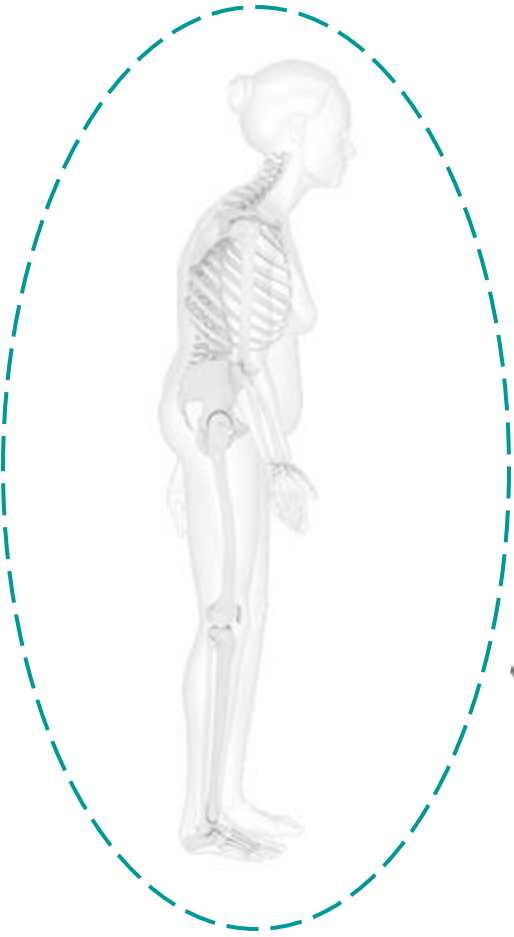


Osteopenic lacunae



Osteopetrotic lacunae

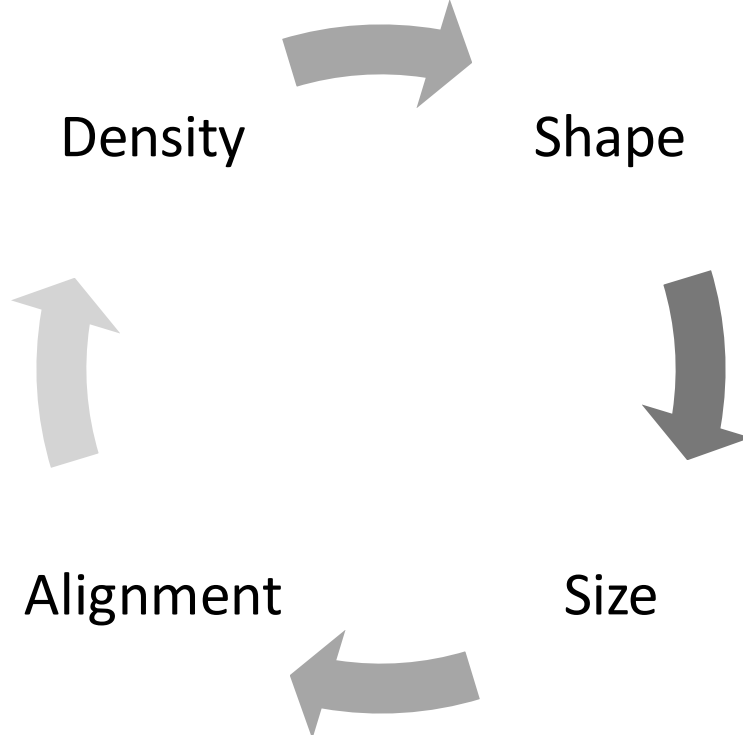
# The effect of pathologies on lacunar network



**Osteoarthritis**

**Osteopenia**

**Osteopetrosis**



# Methodological approach

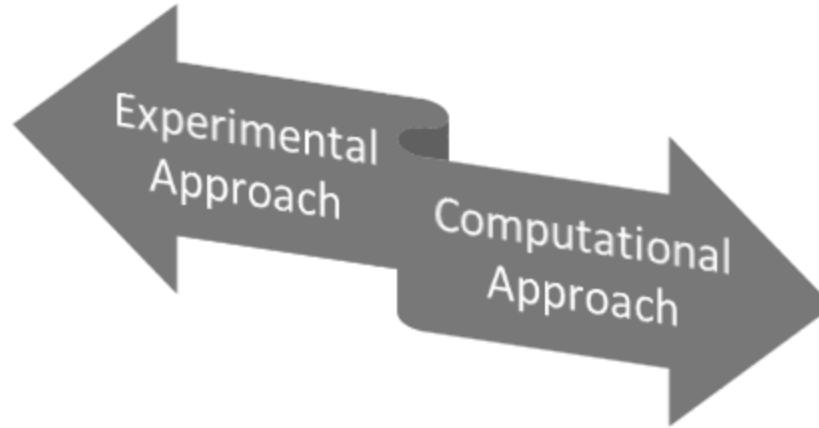
**Additive manufacturing: LPBF**

**Tensile static uniaxial tests**

**Axial fatigue tests**

**Imaging techniques**

microCT, SEM, stereomicroscopy



**Static model**



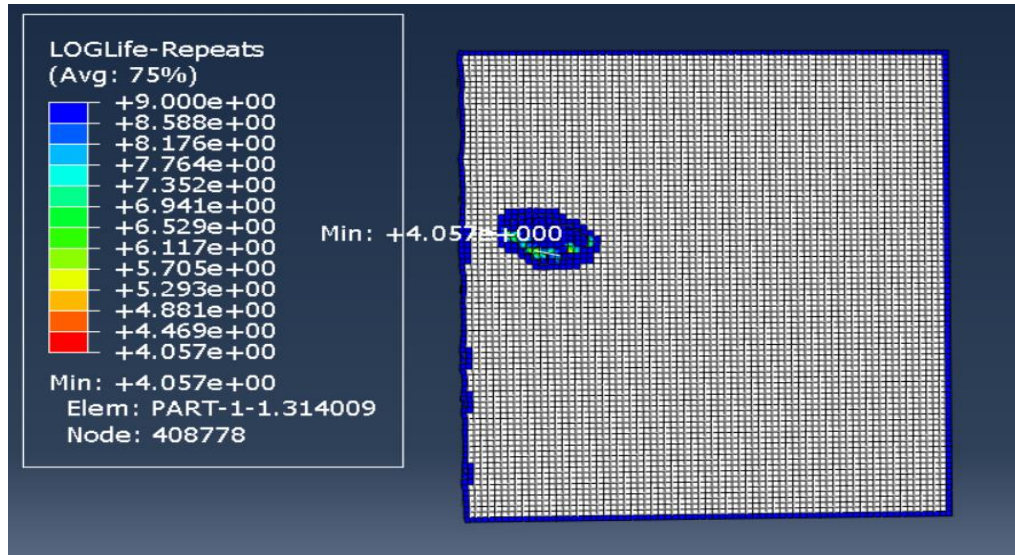
**Fatigue model**

Crack initiation

Crack propagation

# Lacunar network effects

## Computational Outputs

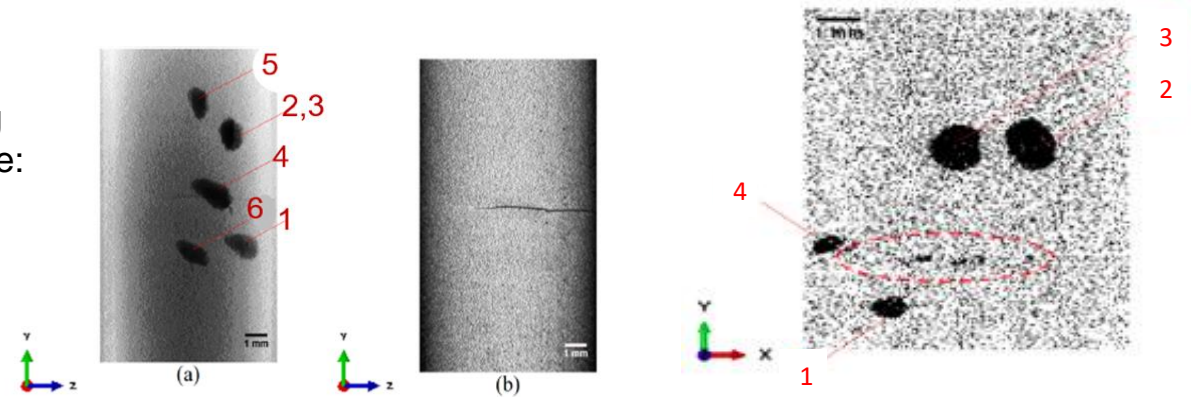


Crack starts from lacuna 4, the closest to the external surface in both types of simulations

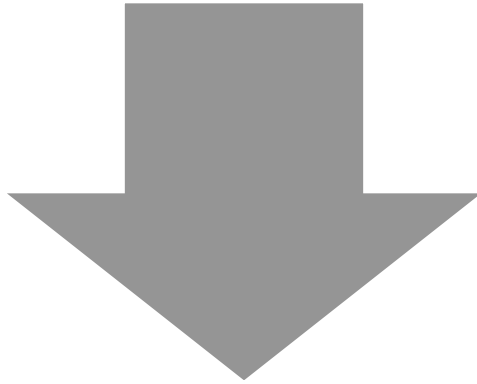
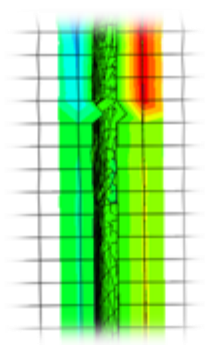
## Experimental Outputs



Imaging technique:  
 $\mu\text{CT}$



# Limitations and future perspectives



High computational effort for the XFEM modeling

Difficulties in testing the samples under compression



Extend the approach to other pathologies

Investigate toughening mechanisms

