

Curriculum vitae

Ting Yang

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Education

- 2021 Ph.D., Department of Mechanical Engineering, **Virginia Tech**
Thesis Title: "Mechanical design of natural ceramic cellular solids"
- 2015 B.S., School of Energy and Power Engineering, **Beihang University**

Research Experience

2017-2021 **Supervisor:** Prof. Ling Li

Projects:

1. Utilizing different material characterization methods; conducting complementary 3D structural, 4D mechanical analysis (synchrotron-based micro-computed tomography (μ -CT) coupled with *in-situ* mechanical test) and finite element analysis to investigate the underlying material structural design strategies of natural ceramic cellular solids for achieving remarkable mechanical performance. Examples include starfish ossicles, echinoderm stereom, and cuttlefish bone.
2. Developing algorithms to acquire, process, and analyze the 3D cellular structures based on μ -CT; extracting efficient feature recognitions of the complex cellular structures at three length scales, i.e., individual node and branch level ($\sim 10\ \mu\text{m}$), local cellular level ($\sim 100\ \mu\text{m}$), and global network level ($\sim 1\ \text{mm}$).
3. Utilizing data-driven machine learning to identify the crack pattern from the complex cellular structures and tomography reconstruction artifacts; implementing machine learning-based phase retrieval, computer vision, and damage identification algorithms to extract various types of damage on the complex cellular structures for extensive volumetric tomography data.
4. Numerical quantification of mechanical performance of cuttlebone-inspired design on the heat sink and integral thermal protection system.

2016-2017 **Supervisor:** Prof. Weiwei Deng

Projects:

(i) Drug delivery with controlled particle size by electrosprays; (ii) Fabrication of hydrophobic film (breath figures and Marangoni convection); (iii) Response of electrified micro-jets.

Publications

Journal articles (: Equal contributions)*

1. Z. Jia, M. C. Fernandes, Z. Deng, T. Yang, Q. Zhang, A. Lethbridge, J. Yin, J-H Lee, L. Han, J. C. Weaver, K. Bertoldi, J. Aizenberg, M. Kolle, P. Vukusic, L. Li, Microstructural design for mechanical-optical multifunctionality in the exoskeleton of the flower beetle *Torynorrhina flammea*. *Proceedings of the National Academy of Sciences of the United States of America* (2021) 118, e2101017118.
2. T. Yang*, Z. Jia*, Z. Deng, H. Chen, W. Liu, L. Chen, L. Li, Mechanical designs of the highly porous cuttlebone: A bioceramic hard buoyancy tank for cuttlefish. *Proceedings of the National Academy of Sciences of the United States of America* (2020) 117, 23450–23459. (PNAS "In This Issue" highlight)
3. T. Yang*, Z. Wu*, H. Chen, Y. Zhu, L. Li, Quantitative 3D structural analysis of the cellular microstructures of sea urchin spines (I): Methodology. *Acta Biomaterialia* (2020) 107, 204–217.
4. H. Chen, T. Yang, Z. Wu, Y. Zhu, L. Li, Quantitative 3D structural analysis of the cellular microstructures of sea urchin spines (II): Large scale analysis. *Acta Biomaterialia* (2020) 107, 218–231.
5. E. Kanimba*, T. Yang*, S. T. Huxtable, L. Li, Z. Tian, Thermomechanical Analysis of a Bio-Inspired Lightweight Multifunctional Structure. *Advanced Engineering Materials* (2020) 2000371, 1–8. (Back cover)
6. Z. Deng, H. Chen, T. Yang, Z. Jia, J. C. Weaver, P. D. Shevchenko, F. D. Carlo, R. Mirzaeifar, L. Li, Strategies for simultaneous strengthening and toughening via nanoscopic intracrystalline defects in a biogenic ceramic. *Nature Communications* (2020) 11(1):1–11.
7. K. R. Phillips, C. T. Zhang, T. Yang, T. Kay, C. Gao, S. Brandt, L. Liu, H. Yang, Y. Li, J. Aizenberg, L. Li, Fabrication of Photonic Microbricks via Crack Engineering of Colloidal Crystals. *Advanced Functional Materials* (2020) 30(26):1–11. (Frontispiece cover)
8. H. C. Hendrikse, A. Weijden, M. Ronda-Lloret, T. Yang, R. Bliem, N. R. Shiju, M. Hecke, L. Li, W. L. Noorduin, Shape-Preserving Chemical Conversion of Architected Nanocomposites. *Advanced Materials* (2020) 32 (52), 2003999.

9. M. Connors*, T. Yang*, A. Hosny, Z. Deng, F. Yazdandoost, H. Massaadi, D. Eernisse, R. Mirzaeifar, M. N. Dean, J. C. Weaver, C. Ortiz, L. Li, Bioinspired design of flexible armor based on chiton scales. *Nature Communications* (2019) 10(1), 1–13.
10. Z. Wu*, T. Yang*, Z. Deng, B. Huang, H. Liu, Y. Wang, H. Lou, L. Li, Y. Zhu, Automatic crack detection and analysis for biological cellular materials in X-ray in-situ tomography measurement. *Integrating Materials and Manufacturing Innovation (IMMI)*, (2019) 8(4), 559-569.
11. R. Seidel, A. Roschger, L. Li, J. J. Bizzarro, Q. Zhang, J. Yin, T. Yang, J. C. Weaver, P. Fratzl, P. Roschger, M. N. Dean, Mechanical properties of stingray tesserae: High-resolution correlative analysis of mineral density and indentation moduli in tessellated cartilage. *Acta Biomaterialia* (2019) 96:421–35.

Manuscripts in submission or preparation (available upon request)

1. T. Yang*, H. Chen*, Z. Jia, Z. Deng, L. Chen, E. M. Peterman, J. C. Weaver, and L. Li. A damage-tolerant, dual-scale, single-crystalline microlattice in nature. *Science*. In revision.
2. T. Yang, Z. Jia, Z. Wu, H. Chen, Z. Deng, L. Chen, Y. Zhu, and L. Li, Extreme strength and damage-tolerance in echinoderm stereom as a natural bicontinuous ceramic cellular solid. Submitted.
3. Z. Wu, T. Yang, L. Li, Y. Zhu, Deep learning enabled autonomous 3D damage detection and characterization for cellular material. In preparation.

Skills and Professional Activities

Experimental Skills Experienced in the following material characterization and mechanical testing methods:

- Synchrotron X-ray tomography coupled with the *in-situ* mechanical testing (compression, indentation, tension, etc.) in Advanced Photon Source at Argonne National Laboratory
- Nanoindentation (embed the biological material in epoxy, polish the sample surface, and conduct nanoindentation using different indenters)
- Focused Ion Beam (FIB) imaging and patterning.
- Transmission electron microscope (TEM) (sample preparations using FIB milling; brightfield, high-resolution TEM imaging).
- Scanning electron microscopy (SEM)
- Atomic Force Microscopy (AFM)
- Instron mechanical testing
- Standard optical microscopy

Softwares Programming Languages	Experienced in post-processing of μ -CT data: use Tomopy to reconstruct the data, ilastik to segment the structure features, and ImageJ and Avizo to analyze the data. Experienced in modeling using SolidWorks and finite element analysis using Abaqus. Programming languages: Matlab and Python. Graphical Softwares: Illustrator, Blender.
Teaching Experience	Instructor of undergraduates Mr. Wenkun Liu and Ms. Liuni Chen on the cuttlebone structure quantification projects in Virginia Tech (Fall 2018 and Spring 2019).
Scientific Memberships	American Society of Mechanical Engineers (ASME)
Referee Service	Acta Biomaterialia

Conferences and Talks

1. T. Yang, W. Liu, L. Li, "Structural basis for the damage tolerance of the low-density cellular structure of cuttlebone" in **TMS** (2019); March 10-14, San Antonio, USA (poster).
2. T. Yang, Z. Wu, L. Li, Y. Zhu, "Sea Urchin Spines: A Natural Lightweight Ceramic Cellular Material," **18th National Congress for Theoretical and Applied Mechanics** (2018), June 4-9, Chicago, USA (oral).
3. Z. Wu, T. Yang, L. Li, Y. Zhu, A hierarchical reconstruction of x-ray phase tomography based on transferred non-local structural features. *SPIE* (2019); 10999, 109990N.
4. Z. Wu, T. Yang, L. Li, Y. Zhu, Hierarchical convolutional network for sparse-view X-ray CT reconstruction. *SPIE* (2019); 10990, 109900V.
5. Z. Wu, T. Yang, L. Li, Y. Zhu, Feature-based sparse angle tomography reconstruction for dynamic characterization of bio-cellular materials. *SPIE* (2018); 10669, 106690O.

Fellowships, Honors, and Awards

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| Mar 2019 | Second Place prize in Best Poster Competition in TMS (Biological Materials Science) |
| Dec 2017 | Pratt Fellowship (Virginia Tech) |

References

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