

**Figure 11:** Top row: from left to right are modular line-based halftoning result [Ahm14], stylized dot pattern [Mon], and our result with 2128 tiles of  $100 \times 120$  resolution, respectively. Bottom row: from left to right are the stippling result [DGBOD12], our result with 2062 tiles of  $100 \times 100$  resolution, and our result with 4953 tiles of  $200 \times 200$  resolution, respectively.

### Acknowledgements

We thank all the anonymous reviewers for their constructive suggestions. This work is supported by the grant No. 61972232 from National Natural Science Foundation of China (NSFC), Science and Technology Program of Shenzhen, China (CJGJZD20200617102202007). Oliver Deussen was funded by the German Research Foundation (DFG)-Project-ID 251654672-TRR 161.

### References

[Ahm14] AHMED A. G. M.: Modular line-based halftoning via recursive division. In *Proceedings of the Workshop on Non-Photorealistic Animation and Rendering - NPAR '14* (2014), ACM Press. doi:10.1145/2630397.2630403. 3, 9

[AM12] ALEXA M., MATUSIK W.: Irregular pit placement for dithering images by self-occlusion. *Computers Graphics* 36, 6 (2012), 635–641. 2011 Joint Symposium on Computational Aesthetics (CAe), Non-Photorealistic Animation and Rendering (NPAR), and Sketch-Based Interfaces and Modeling (SBIM). URL: <https://www.sciencedirect.com/science/article/>

pii/S0097849312000258, doi:<https://doi.org/10.1016/j.cag.2012.02.008>. 3

[BSD09] BALZER M., SCHLÖMER T., DEUSSEN O.: Capacity-constrained point distributions: A variant of lloyd's method. *ACM Transactions on Graphics (TOG)* 28, 3 (2009), 1–8. 3

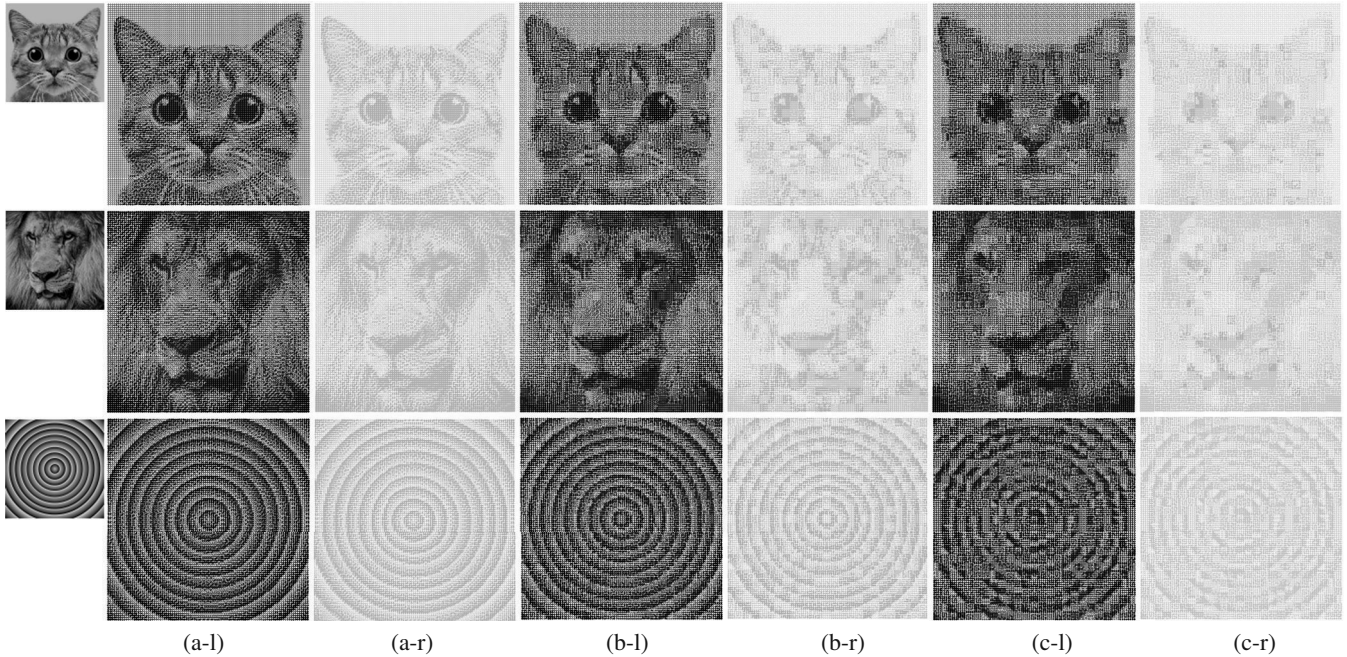
[BWL18] BIAN X., WEI L.-Y., LEFEBVRE S.: Tile-based pattern design with topology control. *Proceedings of the ACM on Computer Graphics and Interactive Techniques I*, 1 (jul 2018), 1–15. doi:10.1145/3203204. 2

[Car18] CARLSON C.: Multi-scale truchet patterns. In *Bridges 2018 Conference Proceedings* (2018), Tessellations Publishing, pp. 39–44. 4

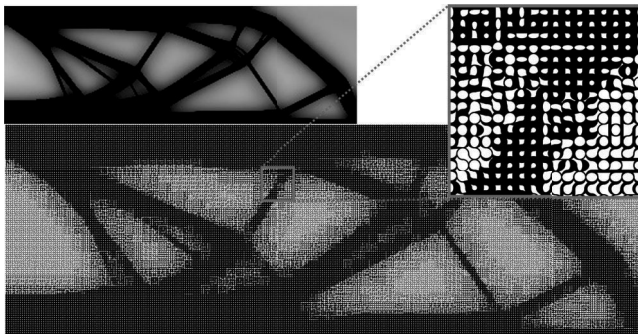
[CLF\*18] CHEN X., LI H., FU C.-W., ZHANG H., COHEN-OR D., CHEN B.: 3d fabrication with universal building blocks and pyramidal shells. *ACM Trans. Graph.* 37, 6 (dec 2018). URL: <https://doi.org/10.1145/3272127.3275033>, doi:10.1145/3272127.3275033. 3

[CML\*17] CHEN W., MA Y., LEFEBVRE S., XIN S., MARTÍNEZ J., WANG W.: Fabricable tile decors. *ACM Transactions on Graphics* 36, 6 (nov 2017), 1–15. doi:10.1145/3130800.3130817. 3

[CSHD03] COHEN M. F., SHADE J., HILLER S., DEUSSEN O.: Wang tiles for image and texture generation. *ACM Transactions on Graphics* 22, 3 (jul 2003), 287–294. doi:10.1145/882262.882265. 1, 2



**Figure 12:** Results of the cat, lion, and rings image (first column) for different scale tiles, shown in both tiling results (left) and placement maps (right). Data of (a-c) is in the three sub-rows of the corresponding images in Table 1, respectively.



**Figure 13:** Given a density field from topology optimization, we apply multi-scale tiling and achieve microstructures that conform to the required densities.

[CZX\*16] CHEN W., ZHANG X., XIN S., XIA Y., LEFEBVRE S., WANG W.: Synthesis of filigrees for digital fabrication. *ACM Transactions on Graphics* 35, 4 (jul 2016), 1–13. doi:10.1145/2897824.2925911. 3

[DGBOD12] DE GOES F., BREEDEN K., OSTROMOUKHOV V., DESBRUN M.: Blue noise through optimal transport. *ACM Transactions on Graphics (TOG)* 31, 6 (2012), 1–11. 3, 7, 9

[DJSJ19] DEROUET-JOURDAN A., SALVATI M., JONCHIER T.: Generating stochastic wall patterns on-the-fly with wang tiles. *Computer Graphics Forum* 38, 2 (may 2019), 255–264. doi:10.1111/cgf.13635. 2

[DLL\*15] DUMAS J., LU A., LEFEBVRE S., WU J., DICK C.: By-

example synthesis of structurally sound patterns. *ACM Trans. Graph.* 34, 4 (jul 2015). URL: <https://doi.org/10.1145/2766984>, doi:10.1145/2766984. 3

[DSZ17] DEUSSEN O., SPICKER M., ZHENG Q.: Weighted linde-buzo-gray stippling. *ACM Transactions on Graphics (TOG)* 36, 6 (2017), 1–12. 3

[DZRN20] DOŠKÁŘ M., ZEMAN J., RYPL D., NOVÁK J.: Level-set based design of wang tiles for modelling complex microstructures. *Computer-Aided Design* 123 (jun 2020), 102827. doi:10.1016/j.cad.2020.102827. 2

[EK21] ELBER G., KIM M.-S.: Synthesis of 3d jigsaw puzzles over freeform 2-manifolds. *Computers Graphics* (2021). URL: <https://www.sciencedirect.com/science/article/pii/S0097849321002259>, doi:<https://doi.org/10.1016/j.cag.2021.10.014>. 3

[EKS\*10] EIGENSATZ M., KILIAN M., SCHIFTNER A., MITRA N. J., POTTMANN H., PAULY M.: Paneling architectural freeform surfaces. In *ACM SIGGRAPH 2010 papers*. 2010, pp. 1–10. 3

[FL05] FU C.-W., LEUNG M.-K.: Texture tiling on arbitrary topological surfaces using wang tiles. The Eurographics Association. doi:10.2312/EGWR/EGSR05/099–104. 2

[FLHCO10] FU C.-W., LAI C.-F., HE Y., COHEN-OR D.: K-set tilable surfaces. *ACM transactions on graphics (TOG)* 29, 4 (2010), 1–6. 3

[HEB15] HUARD M., EIGENSATZ M., BOMPAS P.: Planar panelization with extreme repetition. In *Advances in architectural geometry 2014*. Springer, 2015, pp. 259–279. 3

[KCODL06] KOPF J., COHEN-OR D., DEUSSEN O., LISCHINSKI D.: Recursive wang tiles for real-time blue noise. *ACM Trans. Graph.* 25, 3 (jul 2006), 509–518. URL: <https://doi.org/10.1145/1141911.1141916>, doi:10.1145/1141911.1141916. 1, 2, 3

[Kip01] KIPPAN H.: *Handbook of print media: technologies and production methods*. Springer Science & Business Media, 2001. 3