Visions and Challenges in GeoAI, Ethics, and Spatial Quantum Computing

Andreas Züfle
Department of Geography and GeoInformation Science, George Mason University
Email: azufle@gmu.edu

Geographic information systems are changing rapidly as new technologies, such as advances in artificial intelligence and quantum computing, proliferate. Towards gaining a glimpse of possible new directions for the next decades, it is paramount to disseminate and discuss new research directions, challenges, and visions, that may be of broad interest to the SIGSPATIAL community. In the last few years, our community has excelled at providing a forum for such visions and challenges in dedicated *Vision and Challenge* tracks, leading to many visionary research directions [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21]. A goal of this newsletter is to continue and complement these visions. Three vision and challenge topics are covered in this special issue:

1. the first article is contributed by the organizers of GeoAI, the most successful ACM SIGSPATIAL Workshop of the last years, having 40+ registrations each year, and having 50+ people in the workshop room at a time. The authors survey and summarize the directions of GeoAI publications of the last three years, and provide a list of open research directions for this rapidly advancing field;

2. in the second article, Fu et al. discuss ethical issues of mining urban spatial data. They identify ethical vulnerabilities from three primary research directions of urban computing: urban safety analysis, urban transportation analysis, and social media analysis for urban events;

3. in the third article, Martin Werner introduces central aspects of quantum algorithms and explores future directions on how quantum algorithms can be used to leverage spatial and spatio-temporal algorithms. This article describes example algorithms, such as map coloring and dynamic time warping, which may benefit from advances in quantum computing.

In addition to these vision and challenge papers, this issue also proudly presents UCR-STAR, a spatio-temporal data repository that allows to browser and visualize a plethora of publicly available spatio-temporal data sets, ranging from point and polygon data on OpenStreetMap [22] to commonly used trajectory data sets such as TDrive [23] and GeoLife [24]. Such a repository is particularly useful for PhD students searching for data sets. It allows them to simultaneously explore and visualize many public data sets, and to pick the best for their research needs.

I hope the readers will enjoy this issue and find it useful in their research work. I'd also like to call upon readers to send me suggestions for news that they would like to appear in the next issues of this newsletter. If you have exciting news, visions, and challenges that you would benefit the SIGSPATIAL community, and that you would like to disseminate, please reach out to me! Finally, I want to cordially thank the authors for their excellent contributions to this issue.

References

[1] Y. Xie, S. Shekhar, R. Feiock, and J. Knight, "Revolutionizing tree management via intelligent spatial techniques," in *Proceedings of the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 71–74, ACM, 2019.

[2] H. S. Al-Olimat, V. L. Shalin, K. Thirunarayan, and J. P. Sain, "Towards geocoding spatial expressions (vision paper)," in *Proceedings of the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 75–78, ACM, 2019.

[3] R. A. Alghamdi, A. Magdy, and M. F. Mokbel, "Towards a unified framework for event detection applications," in *Proceedings of the 16th International Symposium on Spatial and Temporal Databases*, pp. 210–213, ACM, 2019.

[4] J. Xu, H. Lu, and R. H. Güting, "Understanding human mobility: A multi-modal and intelligent moving objects database," in *Proceedings of the 16th International Symposium on Spatial and Temporal Databases*, pp. 222–225, ACM, 2019.

[5] H. Kavak, J.-S. Kim, A. Crooks, D. Pfoser, C. Wenk, and A. Züfle, "Location-based social simulation," in *Proceedings of the 16th International Symposium on Spatial and Temporal Databases*, pp. 218–221, ACM, 2019.

[6] G. Giannopoulos and M. Meimaris, "Learning domain driven and semantically enriched embeddings for poi classification," in *Proceedings of the 16th International Symposium on Spatial and Temporal Databases*, pp. 214–217, ACM, 2019.

[7] T. Dasu, Y. Kanza, and D. Srivastava, "Geofences in the sky: herding drones with blockchains and 5g," in *Proceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 73–76, ACM, 2018.

[8] A. Degbelo and C. Kray, "Intelligent geovisualizations for open government data (vision paper)," in *Proceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 77–80, ACM, 2018.

[9] S. Schmoll and M. Schubert, "Vision paper: reinforcement learning in smart spatio-temporal environments," in *Proceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 81–84, ACM, 2018.

[10] O. Wolfson, "Understanding the human brain via its spatio-temporal properties (vision paper)," in *Proceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pp. 85–88, ACM, 2018.

[11] H. Aly, M. Youssef, and A. Agrawala, "Towards ubiquitous accessibility digital maps for smart cities," in *Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, p. 8, ACM, 2017.

[12] T. Dasu, Y. Kanza, and D. Srivastava, "Geotagging ip packets for location-aware software-defined networking in the presence of virtual network functions," in *Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, p. 9, ACM, 2017.

[13] K. Ramamohanarao, J. Qi, E. Tanin, and S. Motallebi, "From how to where: Traffic optimization in the era of automated vehicles," in *Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, p. 10, ACM, 2017.

[14] T. C. van Dijk and A. Wolff, "Algorithmically-guided user interaction," in *Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, p. 11, ACM, 2017.

[15] V. Zakhary, C. Sahin, T. Georgiou, and A. El Abbadi, "Locborg: Hiding social media user location while maintaining online persona," in *Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, p. 12, ACM, 2017.

[16] K. Janowicz and G. McKenzie, "How "alternative" are alternative facts? measuring statement coherence via spatial analysis," in *Proceedings of the ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, 2017.

[17] O. Gkountouna, D. Pfoser, C. Wenk, and A. Züfle, "A unified framework to predict movement," in *International Symposium on Spatial and Temporal Databases*, pp. 393–397, Springer, 2017.

[18] C. Jonathan and M. F. Mokbel, "Towards a unified spatial crowdsourcing platform," in *International Symposium on Spatial and Temporal Databases*, pp. 379–383, Springer, 2017.

[19] M. Sarwat and A. Nandi, "On designing a geoviz-aware database system-challenges and opportunities," in *International Symposium on Spatial and Temporal Databases*, pp. 384–387, Springer, 2017.

[20] K. A. Schmid, A. Züfle, D. Pfoser, A. Crooks, A. Croitoru, and A. Stefanidis, "Predicting the evolution of narratives in social media," in *International Symposium on Spatial and Temporal Databases*, pp. 388–392, Springer, 2017.

[21] Z. Li, "Semantic understanding of spatial trajectories," in *International Symposium on Spatial and Temporal Databases*, pp. 398–401, Springer, 2017.

[22] M. Haklay and P. Weber, "Openstreetmap: User-generated street maps," *IEEE Pervasive Computing*, vol. 7, no. 4, pp. 12–18, 2008.

[23] J. Yuan, Y. Zheng, C. Zhang, W. Xie, X. Xie, G. Sun, and Y. Huang, "T-drive: driving directions based on taxi trajectories," in *Proceedings of the 18th SIGSPATIAL International conference on advances in geographic information systems*, pp. 99–108, ACM, 2010.

[24] Y. Zheng, X. Xie, W.-Y. Ma, *et al.*, "Geolife: A collaborative social networking service among user, location and trajectory.," *IEEE Data Eng. Bull.*, vol. 33, no. 2, pp. 32–39, 2010.