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Non-traditional 2D grids in Image Processing – Advances and Challenges

On the one hand, the digital image processing and many other digital applications are mostly based on the square grid. On the other hand, there are two other regular grids, the hexagonal and the triangular grids. Moreover, there are eight semi-regular grids based on more than one type of tiles. These non-traditional grids and their dual grids have various advantages over the square grid, e.g., on some of them no topological paradoxes occur. Most of them have more symmetries, i.e., more directions of symmetry axes and also a smaller angle rotation may transform most of these grids into themselves. However, since most of these grids are not point lattices, we need to face some challenges to work with them; they may define various digital geometries. We show how a good coordinate system can be characterized, what type of digital distances are studied, tomography and distance transform.

Other grid transformations, including translations and rotations with some of their interesting properties are mentioned. Mathematical morphology and cell complexes are also shown. The advantages and challenges are overviewed by various examples on the triangular grid, as a characteristic example for a non-traditional grid.