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Polyhedral meshes, i.e. meshes with planar faces, recently received a lot of interest because of their potential applications in architecture and industrial design. Avoiding triangle meshes because of their high node complexity, research concentrated mainly on polyhedral quad meshes. They possess an elegant treatment within discrete differential geometry and are capable of approximating arbitrary shapes. However, they are strongly linked to the curvature behavior of the surfaces to be approximated and may not possess sufficient flexibility to satisfy the design intent. As an alternative, various types of patterns different from the quad grid have been investigated, both in real projects and in geometric computing. We report on our recent progress on polyhedral meshes which are combinatorially equivalent to well-known 2D patterns, analyze their flexibility in approximating freeform shapes, discuss ways to handle the arising new forms of smoothness and suggest a computational framework suitable for interactive design and approximation.

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