Consider a graph and imagine that some chips are initially assigned to its vertices. At each time step, they are redistributed in a way that all vertices simultaneously send one chip to each neighbour with fewer chips. This process model is called diffusion and it was introduced by C. Duffy et al. [Discrete Math. Theor. Comput. Sci. 20, No. 1, Paper No. 4, 18 p. (2018; Zbl 1418.91114)].

If $C = (C_0, C_1, \ldots)$ is a sequence of configurations of diffusion, then the period length of $C$ is the minimum positive integer $p$ such that $C_t = C_{t+p}$ for all $t \geq N$, for some natural number $N$. In [J. Long and B. Narayanan, J. Comb. 10, No. 2, 235–241 (2019; Zbl 1403.05099)], it is proved that the period length of every configuration sequence is either 1 or 2. In particular, we say that $C$ is a period configuration if it is in the singleton or in the ordered pair of configurations contained within the period of a configuration sequence.

An important role in the main result of the paper is provided by polyominoes. We recall that a polyomino is a finite and non-empty collection of squares having unitary size and joined edge by edge in the plane. An $h$-strip is a polyomino consisting of a maximal rectangle of height one and an $n$-omino board-pile is a polyomino of $n$ cells having a finite number of $h$-strips and just one per row.

In this paper, the authors prove that the number of period configurations on the complete graph $K_n$ is equal to the number of $n$-omino board-pile polyominoes. As a consequence, they obtain also that the number of period configurations of $K_n$ follows the recurrence relation $a_n = 5a_{n-1} - 7a_{n-2} + 4a_{n-3}$ for $n \geq 5$ with initial values $a_1 = 1$, $a_2 = 2$, $a_3 = 6$, and $a_4 = 19$.

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References:

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