UNIVERSITÄT DUISBURG ESSEN

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Theorie-Kolloquium WS 2021/22

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Kinetics of self-folding at the microscale

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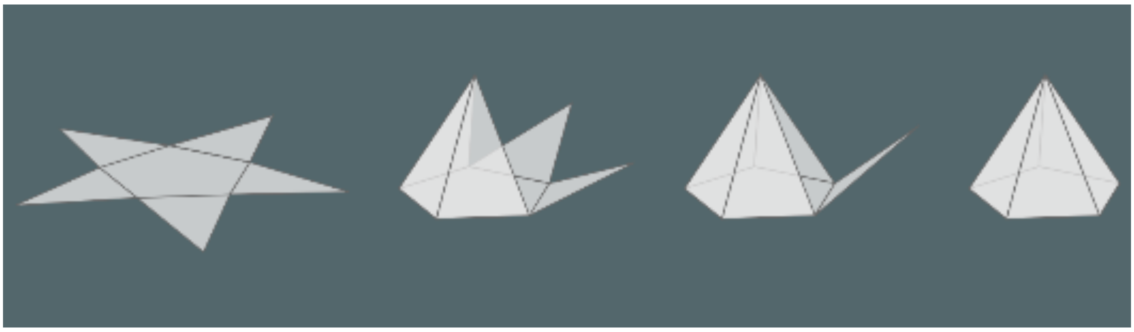

3D shells can be obtained from the self-folding of 2D templates of interconnected panels, called nets. To design self-folding, one first needs to identify what are the nets that fold into the desired structure. In principle, different nets can do it. However, recent experiments and numerical simulations show that the stochastic nature of folding at the microscale might lead to misfolding and so, the probability for a given net to fold into the desired structure (yield) depends strongly on the topology of the net and experimental conditions. Thus, the focus has been on identifying what are the optimal nets that maximize the yield [1]. But, what about the folding time? For practical applications, it is not only critical to reducing misfolding but also to guarantee that folding occurs in due time. Here, we consider as a prototype the spontaneous folding of a pyramid. We find that the total folding time is a non-monotonic function of the number of faces, with a minimum for five faces. We show that it is the interplay between two different sets of events (first and subsequent edge closing) that explains the non-monotonic behavior. Implications in the self-folding of more complex structures are discussed.

[1] N. A. M. Araújo, R. A. da Costa, S. N. Dorogovtsev, J. F. F. Mendes, Physical Review Letters 120, 188001 (2018)

[2] H. P. M. Melo, C. S. Dias, N. A. M. Araújo, Communications Physics 3, 154 (2020)