źródło:
Hergarten, *Self-Organized Criticality In Earth Systems*, Springer 2002

Grassberger (1994) introduced a scheme for determining the time and location of the next event. Let us here discuss a slightly modified version which can easily be transferred to similar models, too. The algorithm hinges on the fact that we can compute the time $t_{i,j}$ when the block (i,j) will become unstable in advance from Eqs. 7.14 and 7.15:

$$t_{i,j} = t + 1 - F_{i,j}(t).$$

The scheme starts with computing $t_{i,j}$ for all blocks. The time axis is subdivided into a certain number of equally-sized bins $[\nu\tau, (\nu+1)\tau[$, where $\nu \geq 0$ is the number of the bin and τ the (arbitrary) bin width. All blocks are ordered into the system of bins according to their values $t_{i,j}$. But what is the advantage of this binning? Imagine that the simulation has arrived at the time t. For proceeding, we must only search the bin with the number ν where ν is the integer part of $\frac{t}{\tau}$ for the block which becomes unstable next. Only if this bin is empty, the subsequent bin must be searched, and so on. So, if the bin width τ is neither too large nor too small, only a few operations are required for determining the block which becomes unstable next.

However, the binning scheme must be permanently maintained throughout the simulation, but this is much less demanding than searching the whole lattice for each earthquake. This result arises from the fact that only the values $t_{i,j}$ of those blocks which have become unstable and of their neighbors are altered as a consequence of an earthquake. Thus, maintaining the binning requires updating the values $t_{i,j}$ of those blocks which are involved in an earthquake and their neighbors and filling them into the bins. This effort is roughly proportional to the size of the earthquake, which is mostly much smaller than the total number of blocks. Therefore, this scheme makes the numerical effort per earthquake nearly independent from the model size, except for the fact that larger grids may generate larger earthquakes.

In its present form, this scheme requires more bins than necessary. At the time t, all blocks fall into the bins with numbers between $\frac{t}{\tau}$ and $\frac{t+1}{\tau}$. Thus, $\frac{1}{\tau}$ bins are in fact necessary, but the lowest bins become empty through time, while new bins must be supplied at the other edge. Originally, Grassberger (1994) fixed this problem by writing the OFC model in a modified form, but there are several other ways which can be transferred to other models such as the two-variable model discussed in Sect. 8.4 more easily. In principle, a periodic bin structure with a period of $1+\tau$ can be used, but we can also let all those blocks where $t_{i,j}$ leaves the range of the bins fall out of the binning system. After some time, all bins have been spent, and all blocks are outside the binning system. Then, a new set of bins is built up and used until it has been spent, too. Compared to the periodic binning system, this procedure looks somewhat crude, but in fact it is advantageous: The whole algorithm works well only if the bin width τ is appropriate. If τ is too large, there are several blocks in each bin, so that too many searches must be performed within the bins. If, in contrast, τ is too small, we must search several empty bins. The highest efficiency is achieved if the number of searches within the bins and the number of searched bins are of the same order of magnitude. From this point of view, the state when all bins have been spent is a good opportunity for optimizing the bin width adaptively.