# A new class of reinforced random walks

**N Y Kotelevskii[1], S K Nechaev[2], M V Tamm[1,3]**

1 Physics Department, Moscow State University, 119992, Moscow, Russia
2 J.-V Poncelet Laboratory, CNRS, UMI 2615, 11 Bolshoy Vlasievski, 119002
Moscow, Russia
3 MIEM, National Research University Higher School of Economics, 101000, Moscow, Russia

We study structural properties of reinforced random walks on a regular lattice using Monte Carlo simulations. Reinforced random walk is a walk whose next step depends on its entire previous trajectory. For example, the probability of a step may depend on whether the target cite is already visited or not. This case, which we call "volume reinforcement", is extensively studied in the literature [1-4]. It is known that depending on the reinforcement parameter *a* (the ratio of probabilities to go to a visited and an unvisited target cite, respectively) there exist a phase transition between collapsed and extended trajectories, which is in many ways analogous to the coil-globule transition in polymer physics [5,6].

Here we propose a generalization of this model with both volume and surface reinforcement. That is to say, the step probability now depends on whether the target site is (a) already visited (volume reinforcement), (b) is adjacent to the visited area (surface reinforcement), (c) neither of the two. As a result, the system behavior is now governed by two parameters - those of volume and surface reinforcement. We present a sketch of the phase diagram of this system depending on the two parameters, which includes four different phases. Apart from the phases known in the volume reinforcement phase there are two new phases with anomalously developed surface. One of these new phases (which was earlier observed in a somewhat different setting in [7]) is highly similar in morphology to the so-called fractal globule conformations of polymer chains and can be used for rapid generation of such conformations.

## References

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