Model of pedestrian races as a social network

M. Rebollo[1,2,†], Javier Galeano[2,‡], Juan Carlos Losada[1,⋆], and Javier LLuch[3,∗]
[1]Grupo de Tecnología Informática-Inteligencia Artificial, Universitat Politècnica de València, Spain
[2]Grupo de Sistemas Complejos, Universidad Politécnica de Madrid, Spain
[3]Instituto Universitario de Automática e Informática Industrial, Universitat Politècnica de València, Spain

Most of the tools that register and tracks the evolution of a race consider runners as individuals. Participants in a race can upload their records, but their progress is isolated from the rest of the group. In this work, a race is studied as a network, where runners are the nodes, and they are linked when the distance between them is below some range.

The network evolves with time as long as the runners' progress and the neighbors' changes depending on their velocity. A factor that has been observed during races is that the path of a runner is affected by the other runners that are around them. A slow runner can increase its path when he or she is close enough to a faster group. Alternatively, runners can be slowed down by their surroundings. Other effects can affect the path, such as the age [6], or the regularity [3, 5]. Besides popular runners, this effect has been observed in professional athletes [1] or even in other sports [2].

Data from the 200 first classified into different races has been retrieved to analyze this effect. Races of different distances are included: from 5000 m to 10000 m, half marathon, and marathon, and also trails with different distances.

Depending on the distance considered among the runners, the network is divided into some groups. With the minimal distance, as many groups as runners are created. Moreover, this number is reduced when longer distances are considered until one connected component is created. All the races behave similarly, and a common pattern emerges: an exponential relation appears between the considered distances for the links and the number of groups created in the network (Fig. 1). All these functions collapsed (Fig. 2), and the parameter of the exponential distribution follows a power law distribution that depends only on the total distance of the race.

This behavior can be used by the organizers to distribute the medical services, organize roadblocks efficiently, or decide the location for provisioning and volunteers.

† E-mail: mrebollo@upv.es

‡ E-mail: javier.galeano@upm.es

⋆ E-mail: juancarlos.losada@upm.es

∗ E-mail: jlluch@upv.es

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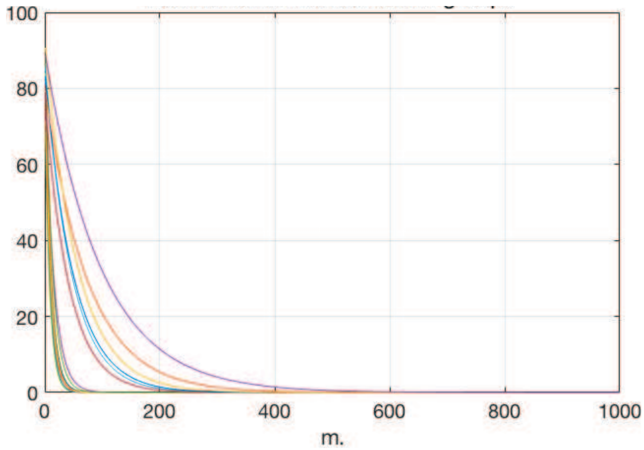

Fig. 1. Size of the groups formed depending on the distance between runners.

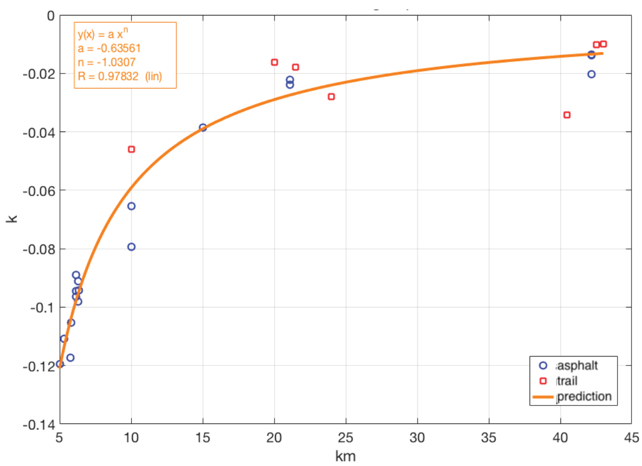

Fig. 2. Relation between groups and distance collapses depending on the length of the race.