ON THE K-METRIC ANTIDIMENSION OF GRAPHS AND ITS APPLICATION TO PRIVACY IN SOCIAL NETWORKS

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Given a connected graph G, a set $S \subset V(G)$ is a *k-antiresolving set* for G, if k is the largest integer such that for all $u \notin S$ there exists a set $S_u \subseteq V(G) \setminus (S \cup \{u\})$ with $|S_u| \geq k-1$ such that $d_G(u,v) = d_G(x,v)$ for every $v \in S$ and every $x \in S_u$, where $d_G(a,b)$ is the distance between a, b. The *k-metric antidimension* of G is the cardinality of a smallest k-ARS for G.

This work focuses on the use of the k-metric antidimension of graphs as a theoretical framework for the privacy measure of social networks called (k,ℓ)-anonymity. A graph G meets *(k,ℓ)-anonymity* with respect to active attacks to its privacy, if k is the smallest positive integer such that the k-metric antidimension of G is not larger than ℓ.

Graphs with a predetermined structure like cylinders, toruses, and 2-dimensional Hamming graphs, as well as, randomly generated graphs are considered, in order to evaluate the (k,ℓ)-anonymity they achieve. We have taken a combinatorial approach for the graphs with a predetermined structure, whereas for randomly generated graphs we have developed an integer programming formulation and computationally tested its implementation. The results indicated that, according to the (k,ℓ)-anonymity measure, only the 2-dimensional Hamming graphs and some general random dense graphs are achieving some higher privacy properties.

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References

[1] E. Fernández, D. Kuziak, M. Muñoz-Márquez, I. G. Yero, On the (k,l)-anonymity of networks via their k-metric antidimension, Scientific Reports (Nature portfolio) 13 (2023) article # 19090.