



Out-tournaments without disjoint cycles of different lengths

LE XUAN HUNG

Abstract. We show in this paper that every strong out-tournament with minimum out-degree 3, except the digraphs D_7^3 and D_8^3 , contains two vertex-disjoint cycles of different lengths.

References

- [1] M. Abreu, R. E. L. Aldred, M. Funk, B. Jackson, D. Labbate and J. Sheehan, Graphs and digraphs with all 2-factors isomorphic, *J. Combin. Theory Ser. B*, **92** (2004), 395 – 404.
- [2] J. Bang-Jensen and G. Gutin, *Digraphs. Theory, Algorithms and Applications*, Springer, New York, 2001.
- [3] J. Bang-Jensen and F. Havet, Tournaments and semicomplete digraphs, In: *Classes of Directed Graphs* (J. Bang-Jensen and G. Gutin, eds), pp. 35 – 124, Springer, New York, 2018.
- [4] J. Bensmail, A. Harutyunyan, N. K. Le, B. Li and N. Lichiardopol, Disjoint cycles of different lengths in graphs and digraphs, *Electron. J. Combin.*, **24** (2017), Article P4.37.
- [5] Y. Gao and D. Ma, Disjoint cycles with different length in 4-arc-dominated digraphs, *Oper. Res. Lett.*, **41** (2013), 650 – 653.
- [6] Z. He, P. Cheng and Y. Gao, Disjoint cycles of different lengths in 3-regular digraphs, *Graphs Combin.*, **38**(3) (2022), Article 74.
- [7] M. A. Henning and A. Yeo, Vertex disjoint cycles of different length in digraphs, *SIAM J. Discrete Math.*, **26**(2012), 687 – 694.
- [8] L. X. Hung, D. D. Hieu and N. D. Tan, Vertex-disjoint cycles of different lengths in multipartite tournaments, *Discrete Math.*, **345**(2022), Article 112819.
- [9] L. X. Hung and N. D. Tan, Vertex-Disjoint Cycles of Different Lengths in Local Tournaments. *Graphs Combin.*, **39**(5) (2023), Article 92.

- [10] L. X. Hung, Vertex-disjoint cycles of different lengths in tournaments of cycles, *Sib. Electron. Math. Rep.*, **22**(1) (2025), 46 – 53.
- [11] L. X. Hung, Vertex-disjoint cycles of different lengths in tournaments of cycles, *Australas. J. Combin.* **93**(2), (2025), 398–407.
- [12] N. Lichiardopol, Proof of a conjecture of Henning and Yeo on vertex-disjoint directed cycles, *SIAM J. Discrete Math.*, **28** (2014), 1618 – 1627.
- [13] R. M. Steiner, Disjoint cycles with length constraints in digraphs of large connectivity or large minimum degree, *SIAM J. Discrete Math.*, **36**(2) (2022), 1343 – 1362.
- [14] N. D. Tan, Vertex disjoint cycles of different lengths in d -arc-dominated digraphs, *Oper. Res. Lett.*, 42 (2014), 351 – 354.
- [15] N. D. Tan, On vertex disjoint cycles of different lengths in 3-regular digraphs, *Discrete Math.*, **338** (2015), 2485 – 2491.
- [16] N. D. Tan, On 3-regular digraphs without vertex disjoint cycles of different lengths, *Discrete Math.*, **340** (2017), 1933 – 1943.
- [17] N. D. Tan, On 3-regular digraphs of girth 4, *Discrete Math.*, 342 (2020), Article 111632.
- [18] N. D. Tan, Tournaments and bipartite tournaments without vertex disjoint cycles of different lengths, *SIAM J. Discrete Math.*, **35**(1) (2021), 485 – 494.
- [19] N. D. Tan, A decomposition for digraphs with minimum outdegree 3 having no vertex disjoint cycles of different lengths, *Discuss. Math. Graph Theory*, **43** (2023), 573 – 581.
- [20] C. Thomassen, Disjoint cycles in digraphs, *Combinatorica*, **3** (1983), 393 – 396.
- [21] A. Yeo, Semicomplete multipartite digraphs, In: *Classes of Directed Graphs* (J. Bang-Jensen and G. Gutin, eds), pp. 297 – 340, Springer, New York, 2018.

LE XUAN HUNG

HANOI UNIVERSITY OF INDUSTRY, 298 CAU DIEN ROAD, HANOI, VIETNAM

hunglx@fit-hau1.edu.vn

 0009-0009-2333-3522