

# Chip-firing games, potential theory on graphs, and spanning trees

Matthew Baker, Farbod Shokrieh

(Submitted on 7 Jul 2011 (v1), last revised 25 Jul 2012 (this version, v2))

We study the interplay between chip-firing games and potential theory on graphs, characterizing reduced divisors (G-parking functions) on graphs as the solution to an energy (or potential) minimization problem and providing an algorithm to efficiently compute reduced divisors. Applications include an "efficient bijective" proof of Kirchhoff's matrix-tree theorem and a new algorithm for finding random spanning trees. The running times of our algorithms are analyzed using potential theory, and we show that the bounds thus obtained generalize and improve upon several previous results in the literature. We also extend some of these considerations to metric graphs.

Comments: To appear in Journal of Combinatorial Theory, Series A -- Revised and updated. The discussion on metric graphs (now in Appendix A) will not appear in the journal version. Proofs of the Dhar theorem and the Cori-Le Borgne theorem are in v1 but not in v2

Subjects: **Combinatorics (math.CO)**

MSC classes: 05C05, 05C25, 05C50, 05C57, 05C85

Journal reference: Journal of Combinatorial Theory, Series A 120 (2013) pp. 164-182

DOI: [10.1016/j.jcta.2012.07.011](https://doi.org/10.1016/j.jcta.2012.07.011)

Cite as: [arXiv:1107.1313](https://arxiv.org/abs/1107.1313) [math.CO]

(or [arXiv:1107.1313v2](https://arxiv.org/abs/1107.1313v2) [math.CO] for this version)

## Submission history

From: Farbod Shokrieh [[view email](#)]

[v1] Thu, 7 Jul 2011 08:12:34 GMT (37kb)

[v2] Wed, 25 Jul 2012 06:14:25 GMT (32kb)

*[Which authors of this paper are endorsers?](#)*

## Download:

- [PDF](#)
- [PostScript](#)
- [Other formats](#)

Current browse context:

math.CO

[< prev](#) | [next >](#)

[new](#) | [recent](#) | [1107](#)

Change to browse by:

[math](#)

References & Citations

- [NASA ADS](#)

Bookmark([what is this?](#))



Science  
WISE