Connectivity-Constrained Placement of Wireless Chargers

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***Abstract*—In this article, we first study the problem of Connected wIReless Charger pLacEment (CIRCLE). That is, given a fixed number of directional wireless chargers and candidate positions, determining the placement position and orientation angle for each charger under connectivity constraint for wireless chargers such that the overall charging utility is maximized. To address CIRCLE problem, we first consider a relaxed version of CIRCLE (CIRCLE-R for short). We prove that CIRCLE-R falls into the realm of maximizing a submodular set function subject to a connectivity constraint, and propose an algorithm whose approximation ratio is at least 1.5 times better than that of the state-of-the-art algorithm. Next, we reduce the solution space for CIRCLE from infinite to finite, and propose an algorithm with a constant approximation ratio to address CIRCLE. Besides, we consider a variant of CIRCLE, CIRCLE-NB, and propose an approximation algorithm to address it. We conduct both simulation experiments and field experiments to verify our theoretical findings. The results show that our algorithm can outperform comparison algorithms by 83.35 percent.**

***Index Terms*—Connectivity, directional charging, wireless power transfer, approximation algorithm.**

I. Introduction

See [1]–[5] for resources on formatting math into text and additional help in working with.

II. Text

For some of the remainer of this sample we will use dummy text to fill out paragraphs rather than use live text that may violate a copyright.

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$$x = \sum_{i=0}^{n} 2iQ. \tag{1}$$

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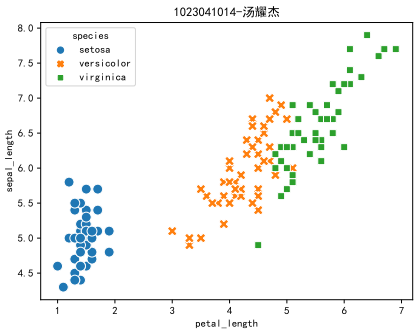

Fig. 1. Simulation results for the network.

TABLE I
An Example of a Table

One	Two
Three	Four

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III. Picture

Fig. 1 is an example of a floating figure using the graphicx package.

IV. Tables

Note that, for IEEE-style tables, the caption command should come BEFORE the table. Table captions use title case. Articles (a, an, the), coordinating conjunctions (and, but, for, or, nor), and most short prepositions are lowercase unless they are the first or last word. Table text will default to footnotesize as the IEEE normally uses this smaller font for tables.

V. Algorithms

Algorithms should be numbered and include a short title. They are set off from the text with rules above and below the title and after the last line.

Algorithm 1 Weighted Tanimoto ELM.

TRAIN($\mathbf{XT}$)
select randomly $W \subset \mathbf{X}$
$N_{\mathbf{t}} \leftarrow |\{i : \mathbf{t}_i = \mathbf{t}\}|$ **for** $\mathbf{t} = -1, +1$
$B_i \leftarrow \sqrt{\text{MAX}(N_{-1}, N_{+1})/N_{\mathbf{t}_i}}$ **for** $i = 1, ..., N$
$\beta \leftarrow \left(I/C + \hat{\mathbf{H}}^T\hat{\mathbf{H}}\right)^{-1} (\hat{\mathbf{H}}^T B \cdot \mathbf{T})$
return $\mathbf{W}, \beta$

PREDICT($\mathbf{X}$)
return SIGN($\mathbf{H}\beta$)

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