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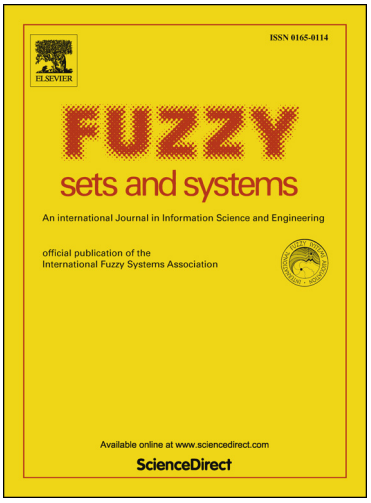

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PII: S0165-0114(16)30394-3
DOI: http://dx.doi.org/10.1016/j.fss.2016.11.007
Reference: FSS 7125

To appear in: *Fuzzy Sets and Systems*

Received date: 27 August 2015
Revised date: 14 November 2016
Accepted date: 23 November 2016

Please cite this article in press as: H. Huang, C. Wu, Characterizations of compact sets in fuzzy set spaces with L_p metric, *Fuzzy Sets Syst.* (2016), http://dx.doi.org/10.1016/j.fss.2016.11.007

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Characterizations of compact sets in fuzzy set spaces with L_p metric ☆

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Abstract

Compactness criteria in fuzzy set spaces endowed with the L_p metric have been studied for several decades. Total boundedness is a key feature of compactness in metric spaces. However, comparing existing compactness criteria in fuzzy set spaces endowed with the L_p metric with the Arzelà-Ascoli theorem, the latter gives compactness criteria by characterizing totally bounded sets while the former does not characterize totally bounded sets. Currently, compactness criteria are only presented for three particular fuzzy set spaces under assumptions of convexity or star-shapedness. General fuzzy sets have become more important in both theory and applications. Therefore, this paper presents characterizations of totally bounded sets, relatively compact sets, and compact sets in general fuzzy set spaces equipped with the L_p metric, but which do not have any assumptions of convexity or star-shapedness. Subsets of these general sets include common fuzzy sets, such as fuzzy numbers, fuzzy star-shaped numbers with respect to the origin, fuzzy star-shaped numbers, and general fuzzy star-shaped numbers. Existing compactness criteria are stated for fuzzy number space, the space of fuzzy star-shaped numbers with respect to the origin, and the space of fuzzy star-shaped numbers endowed with the L_p metric, respectively. Constructing completions of fuzzy set spaces with respect to the L_p metric is a problem closely dependent on characterizing totally bounded sets. Based on characterizations of total

☆Project supported by National Natural Science Foundation of China (No. 61103052), and by Natural Science Foundation of Fujian Province of China(No. 2016J01022)

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