COMMUNICATIONS IN INFORMATION AND SYSTEMS
Vol. 10, No. 3, pp. 183-192, 2010

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EQUIDISTANT RANK METRIC CODES: CONSTRUCTION AND PROPERTIES

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Abstract. This paper introduces a new construction for q-ary equidistant code $\mathfrak{C}$ with rank metric where q is a power of 2. Investigations on structural properties of the proposed code are carried out. The highlight of the paper is that the kernel of the code $\mathfrak{C}$ happens to be an equidistant constant-weight code of same size as $\mathfrak{C}$ and is shown to be $\mathfrak{C} + \mathfrak{C}$. The bounds on number of steps that are required to construct the equidistant code are also given. Moreover, our construction is independent of the choice of metric, though our investigation mainly focuses about rank metric.

Keywords: rank metric codes; equidistant codes; constant-weight codes; kernel

1. Introduction. Recently, codes in rank metric have attracted great attention due to their relevance to wireless communications, cryptography, storage equipments, network coding etc [5, 6, 7, 13, 14]. While a vast amount of knowledge exists for non-linear binary codes with Hamming metric, a relatively little is known about non-linear q-ary codes with rank metric. The majority of previous works on rank metric codes were about rank distance properties, code construction, efficient decoding of rank metric codes. The works in [5, 10, 11, 12, 13, 17], have made significant contribution to these topics. Most of the studies regarding non-linear codes with Hamming metric revolved around perfect codes, equidistant codes and constant-weight codes. Binary equidistant codes have been studied by a number of authors, mainly as examples of designs and other combinatorial objects, for example see [8, 9]. There are no perfect codes [2, 16] with respect to rank metric. Plenty of knowledge exists regarding equidistant codes on binary codes, but as to our knowledge, equidistant rank metric codes have not been investigated. All these inspired us to think of a method of constructing equidistant rank metric codes. Constructing such equidistant codes discloses several properties of the nonlinear behavior of rank metric codes. Moreover, such equidistant codes also led us finding the way to construct constant-weight rank metric codes, applicable to communications, for instance, detecting error signals in ARQ system [4].

Hence this paper is aimed to provide a new technique to construct an equidistant rank metric code, from which we explore various properties possessed by it by investigating its kernel. The kernel of a code C, denoted by $Ker(C)$, is the set of vectors that leave C invariant under translation.

The remainder of this paper is arranged as follows. In section 2, we summarize

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