Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **30 (2023)** 271-285

COMPUTATIONS FOR CYCLIC, CYCLIC LCD AND CYCLIC DUAL CONTAINING CODES IN SAGEMATH

Arunkumar Patil [1] and Pooja Rajani[2]

[1]Department of Mathematics
S.G.G.S. Institute of Engineering and Technology, Vishnupuri, Nanded, India
arun.iitb@gmail.com

[2]Department of Mathematics
Smt.Chandibai Himathmal Mansukhani College, Ulhasnagar, Mumbai, India
poojarochani.d@gmail.com

Abstract. This paper aims at creating user defined functions in SageMath for various computations required for cyclic codes of length n over $\mathbb{F}_q$ with $gcd(n, q) = 1$. SageMath code to display all $q-$ cyclotomic cosets modulo n along with its type and associated cyclotomic coset is defined in this paper, where $gcd(n, q) = 1$. The paper also defines SageMath functions which accept a list of integers from distinct cyclotomic cosets and return whether the associated cyclic code (whose generating set is union of cyclotomic cosets containing integers in a list) is LCD or dual containing code. Further, the paper proves that componentwise product and sum of two cyclic LCD codes over $\mathbb{F}_q$ of length n with $gcd(n, q) = 1$ are again cyclic LCD codes and verifies it using SageMath codes.

Keywords. Linear code, cyclic code, LCD code, Dual containing code, Matrix product code.

1 Introduction

Let $\mathbb{F}_q$ be a finite field of size q, where q is a power of a prime. An $[n, k]$-linear code over $\mathbb{F}_q$ is a $k-$ dimensional subspace of $\mathbb{F}_q^n$ as a vector space over $\mathbb{F}_q$. Linear complementary Dual codes (LCD codes) are linear codes that intersect with its dual trivially. An LCD code over a finite field $\mathbb{F}_q$ was first introduced by Massey in [16]. He demonstrated that asymptotically good LCD codes exist. Yang and Massey in [20] provided the necessary and sufficient condition for a cyclic code to be an LCD code. Sendrier proved in [17] that LCD code meet the asymptotic GilbertVarshamov bound. In [6] Esmaeili and Yari studied LCD Quasi cyclic code and obtained necessary and sufficient conditions for certain classes of quasi cyclic code to be LCD codes. Authors in [11] and [10] investigated parameters of two classes of LCD BCH codes