

# The CMV bispectral problem

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## Abstract

A classical result due to Bochner classifies the orthogonal polynomials on the real line which are common eigenfunctions of a second order linear differential operator. We settle a natural version of the Bochner problem on the unit circle which answers a similar question concerning orthogonal Laurent polynomials and can be formulated as a bispectral problem involving CMV matrices. We solve this CMV bispectral problem in great generality proving that, except the Lebesgue measure, no other one on the unit circle yields a sequence of orthogonal Laurent polynomials which are eigenfunctions of a linear differential operator of arbitrary order. Actually, we prove that this is the case even if such an eigenfunction condition is imposed up to finitely many orthogonal Laurent polynomials.

*Keywords and phrases:* bispectral problems, differential operators, CMV matrices, orthogonal Laurent polynomials, measures on the unit circle

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## 1 Introduction

The motivation for the problem we address here can be traced to work in signal processing started by C. Shannon [39]. Addressing his problem required finding and exploiting some remarkable mathematical miracles and was accomplished in a series of papers by three workers at Bell Labs in the 1960's: David Slepian, Henry Landau and Henry Pollak, see [32, 33, 42–46]. The most important of these miracles is the existence of a second order differential operator that commutes with Shannon's time-and-band limiting integral operator.

In an effort to understand and extend the range of applicability of these miracles one of us introduced the so called “bispectral problem”, see [5]. For connections of this notion with the “time-and-band limiting problem” of Shannon see for instance

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