In this project we are dealing with the analytic properties of families of orthogonal polynomials with respect to several models of inner products and, on the other hand, we explore their scientific and technological applications (the modellisation of several discrete systems of quantum oscillators and other physical and biological systems like macromolecules and molecular motors among other illustrative examples). More precisely, we will focus our attention on three cases of orthogonality where the teams involved in the project have a recognized experience and worldwide leadership. (a) Matrix orthogonality with respect to a positive definite matrix of
measures supported on the real line. Here we will deal with the spectral study of second order linear differential operators whose coefficients are matrix polynomials and their eigenfunctions are matrix orthogonal polynomials. As applications, we will consider the modelling of relativistic quantum systems (Dirac equation) with Coulombian potential, discrete Markov chains when the interactions are not reduced to the closest neighbors and other problems with potential impact on the diagnosis by medical imaging using tensor tomography. (b) Sobolev orthogonality where the derivatives of polynomials are involved in the weighted inner product. These orthogonal polynomials present some advantages with respect to the standard ones when spectral methods are considered in the numerical analysis of boundary value problems both for differential and partial differential equations as well as they improve the standard techniques in Approximation Theory when Fourier-Sobolev expansions are considered. (c) Orthogonality with respect to vector measures and their applications in the study of some dynamical systems (infinite dimensional SIMO systems).

We will also deal with other related fields: Moment problem theory, rational approximation (mainly Padé approximants and their extensions, with applications in the study of the stability of time delay dynamical systems) as well as computational methods for Special Functions of relevance in physical-mathematical models, Number Theory, numerical quadrature, Fourier series, and Operator Theory. The techniques that we will use are Matrix Analysis, Potential Theory, Fourier Analysis, Operator Theory, Interpolation, and
List of Publications

(you can download a copy of a given paper visiting the home page of a team member)

1.- F. Marcellán, Xh. Fejzullahu, A Cohen inequality for Fourier expansions of orthogonal polynomials with a non-discrete Jacobi-Sobolev inner product. Journal of Inequalities and...
22 páginas.


5.- A. Branquinho, F. Marcellán, A. I. Mendes, Vector interpretation of the matrix orthogonality on the real line. Acta Applicandae


16.- F. Lledó, Modular Theory by example, Contemporary Mathematics 534, American Mathematical Society, Providence, Rhode Island, 2011.73-96.


18.- M. Alfaro, F. Marcellán, A. Peña, M. L. Rezola, Orthogonal polynomials associated


22.- F. Marcellán, S. M. Zagorodnyuk, Density
of polynomials in some L2 spaces on radial rays in the complex plane. Linear Algebra and its Applications 435 (2011) 128-146.


26.- U. Fidalgo, G. López Lagomasino. Nikishin systems are perfect. Constructive


37.- H. Pijeira, Y. Quintana, J. M. Rodríguez, Sobolev formal orthogonality on algebraic curves and extensions of Favard theorem, Jaen Journal of Approximation 3 (2) (2011),
193-207.


40.- A. Alaya, B. Bouras, F. Marcellán, A non-symmetric second degree semi-classical form of class one, Integral Transforms and Special Functions. 23 (2012) 149-159.


50.- A. Branquinho, A. Mendes, F. Marcellán, Relative asymptotics for orthogonal matrix


54.- P. Hästö, H. Linden, A. Portilla, J. M. Rodríguez, E. Tourís, Gromov hyperbolicity of Denjoy domains with hyperbolic and quasihyperbolic metrics, Journal of the


71.- B. Xh. Fejzullahu, F. Marcellán, J. J. Moreno-Balcázar, Jacobi-Sobolev orthogonal polynomials: asymptotics and a Cohen type


74.- B. Alaoui, F. Marcellán, R. Sfaxi, Classical orthogonal polynomials with respect to a lowering operator generalizing the Laguerre operator, Integral Transforms and Special Functions 24 (2013) 636-648.

75.- E. Huertas, F. Marcellán, M. Masjed-Jamei, A Finite class of orthogonal


