THE UNIVERSITY OF NEW SOUTH WALES
Thesis/Dissertation Sheet

Surname or Family name: LEOPARDI

First name: Paul   Other name/s: Charles Dominic

Abbreviation for degree as given in the University calendar: Mathematics PhD 1880

School: Mathematics   Faculty: Science

Title: Distributing points on the sphere: Partitions, separation, quadrature and energy

Abstract 350 words maximum: (PLEASE TYPE)

This thesis concentrates on a set of problems and approaches relating to the generation and analysis of spherical codes.

The work was conducted at the University of New South Wales between 2002 and 2006, during a short visit to Vanderbilt University in 2004, and at the University of Sydney in 2006. The key results include:

1. A description of an equal area partition of the unit sphere S^d called the EQ partition.
2. A detailed description of the EQ algorithm which produces the EQ partition.
3. Proofs that EQ partitions are equal area partitions with small diameter.
4. A detailed description of the construction of a spherical code called the EQ code, based on the EQ partition.
5. A proof that the sequence of EQ codes is well separated.
6. An examination of the suitability of the EQ codes for polynomial interpolation.
7. An examination of the packing density of the EQ codes.
8. Modified constructions of the EQ codes to allow nesting or to maximize the packing radius.
9. A scheme to use the EQ partitions and EQ codes for spherical coding and decoding.
10. A proof that for $0 < s < d$ a sequence of S^d codes which is well separated and weak star convergent has a Riesz s energy which converges to the corresponding energy double integral.
11. A bound on the rate of convergence of Riesz s energy given the rate of convergence to zero of the spherical cap discrepancy.
12. A comparison of Coulomb energy estimate for S^2 spherical designs given by Hesse and Leopardi, 2004 with estimates obtained using only the separation and the estimated spherical cap discrepancy of the spherical designs.
13. A proof that the EQ codes are weak star convergent.
14. Estimates of the rate of convergence to zero of the spherical cap discrepancy of EQ codes.
15. Estimates of the rate of convergence of Riesz s energy of EQ codes to the energy double integral.

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