PLEASE TYPE

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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