Research at TUT/mathematics
Seppo Pohjolainen

Control of distributed parameter systems

- generalises the theory of linear feedback controllers for finite dimensional systems to infinite-dimensional ones: parabolic (diffusion), hyperbolic (vibration), and systems with delays. These are described with strongly continuous semigroups in suitable Hilbert space.
- 2 assistants, 1 TISE student
- some publications
Keijo Ruohonen

**Formal languages & automata**

**Applied statistics**
- biostatistics
- dependability and cost design
  - simulation & calculation software (with TUT Machine Design Inst.)
- bayesian methods
  - seminar in spring 2004,
    Robert & Casella: *Monte Carlo Statistical Methods*
Boolean functions
via universal algebra
• Ekin, *, Hammer, Hellerstein: Equational characterizations of boolean function classes, *Discrete Math*. 2000 (see Td 4th floor)
• *, Equational classes of boolean functions via the HSP theorem, *Algebra Universalis*, 2000

via linear algebra:
• Couceiro, *: Definability of boolean function classes…, *Discrete Applied Math*,

via convex geometry:
• *, Hammer: Disjunctive and conjuctive representations in finite lattices and convexity spaces, *Discrete Math* 2002

Convex geometry

Real-valued functions of Boolean variables
• *, Hammer, Submodularity, supermodularity and higher order monotonicities of pseudo-boolean functions, 2002, rutcor.rutgers.edu/~rrr

Topics in matrix algebra
• *, Meletiou, On incidence algebras and triangular matrices, 2002, rutcor.rutgers.edu/~rrr

Students
– Miguel Couceiro's (UTa) master's thesis received the Finnish Math Society Varma-Sampo prize in 2003
Many-valued logical systems

• *Mathematics Behind Fuzzy Logic (Physica-Verlag, 1999)*
  
  shows e.g. that Zadeh's fuzzy logic and fuzzy set theory can be regarded as a well-defined mathematical many-valued logic and algebraically corresponding to an injective MV-algebra.

• **Many-valued equivalence (fuzzy similarity)**
  
  traffic signal design, traffic flow models, real-time reservoir operation, and sports medicine

• **Many-valued logic & quantum computation**
  
  with Keijo Ruohonen

• **GUHA data mining**
  
  intl. data mining workshop summer 2004
  
  intensive course in May 2004  [math.tut.fi/~eturunen/GUHA.html](http://math.tut.fi/~eturunen/GUHA.html)

• **PhD students**
  
  1 at TUT, 1 at UKK, 3 at LUT
Mixed Integer Optimization and Industrial Applications

- methods for practical optimization problems with integer variables.
- financed by Tekes and some private companies.
- group includes 3 TUT students and Heikki Parviainen of VTT
- The main theoretical interests are in multiple objective mixed integer linear & nonlinear optimization and multiple objective network optimization.
- applications in logistical industrial problems.
Robert Piché

Positioning

- group funded by Nokia since 2000
- some publications:
  - Syrjärinne, *: Method and apparatus for satellite orbit interpolation using piecewise Hermite interpolating polynomials, US patent 727371, 2000

Image processing

- Solving multidimensional inverse problems that have Kronecker structure (e.g. deblurring, NMR)
- mosaicking images of IC circuits (for an Ottawa firm)