

UNIVERSITY OF DELAWARE
DEPARTMENT OF MATHEMATICAL SCIENCES
DISCRETE MATHEMATICS SEMINAR

Friday March 21, 2003, 3:45pm, Room 436 Ewing Hall

**“Only a Student Would Try
That”: How to Construct
Binary Sequences with Merit
Factor greater than 6.34**

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The study of the merit factor of binary sequences occurs as a classical problem of signal design for digital communication and, in equivalent guise, in analytic number theory. It has also become a notorious problem of combinatorial optimization. For thirty years mathematicians, engineers, physicists and chemists have sought a systematic way to construct long binary sequences with large merit factor. All previous work has led to an asymptotic merit factor no larger than six.

In Summer 1999, Jim Davis of the University of Richmond supervised students Tony Kirilusha and Ganesh Narayanaswamy in an investigation of this problem. The students discovered a new method of constructing good sequences that suggested it might be possible reliably to attain a merit factor greater than six.

After conducting extensive computational experiments, Peter Borwein, Stephen Choi and I found a way to develop the students' method into a systematic construction for long binary sequences. We can obtain a merit factor greater than 6.34 for sequences up to millions of elements long. We cannot yet prove that the construction will work for arbitrarily long sequences, but have used numerical evidence to formulate a precise conjecture which would imply this result.

I shall describe from first principles the merit factor problem and show how it arises in multiple disciplines. I shall then tell the story linking the students' work to the recent results, and present evidence in support of the explanatory conjecture.