Tests of the Daugman Iris Recognition Algorithms

Testing Organisation	*Number of Cross-Comparisons*	*False Matches*
Sandia Labs[1], USA (1996)	**19,701**	0
British Telecom Labs[2], UK (1997)	**222,743**	0
Sensar Corp.[3], USA (2000)	**499,500**	0
Joh.Enschedé[4], NL (2000)	**19,900**	0
EyeTicket[5], USA (2001)	**300,000**	0
National Physical Lab[6], UK (2001)	**2.73 million**	0
J. Daugman[7], UK (2003)	**9.1 million**	0
Iridian Technologies[8], USA (2003)	**984 million**	0

References

(1) Sandia Report *SAND 96-1033* (1996), Systems Engineering Department, Sandia National Laboratories. Result cited also on p. 38, *Scientific American,* April 1996.

(2) C. Seal, M. Gifford, and D. McCartney (1997), "Iris recognition for user validation," *British Telecommunications Engineering Journal* vol. 16, no. 7, pp. 113-117.

(3) M. Negin *et al.* (2000), "An iris biometric system for public and personal use," *Computer,* vol. 33, no. 2, pp. 70-75.

(4) see attached performance histograms (Enschedé, 25 September 2000). Also unpublished but available on-line is Test Report *IrisEval4.doc* (March 11, 1999) from the National Biometric Test Center, San Jose State University, again reporting 0 False Matches in all tests.

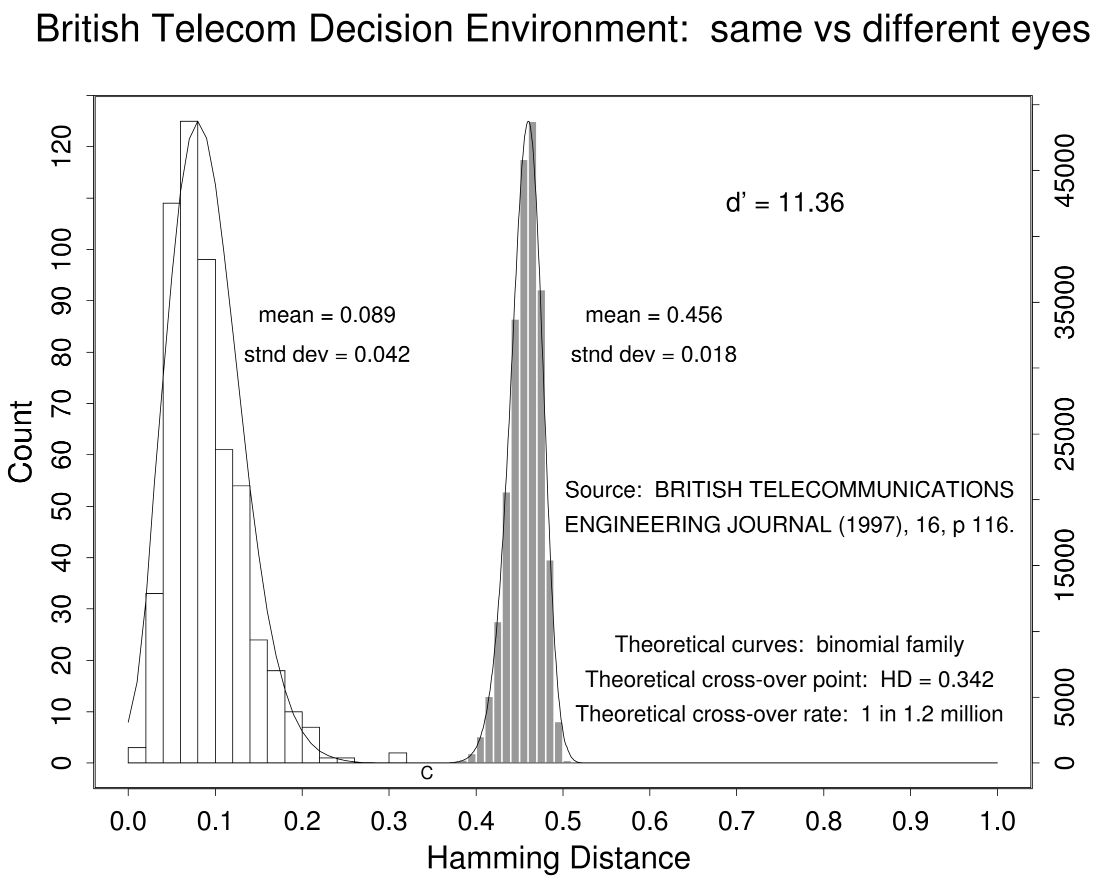
(5) from EyeTicket press releases; see *e.g.* `http://www.eyeticket.com/eyepass/index.html`

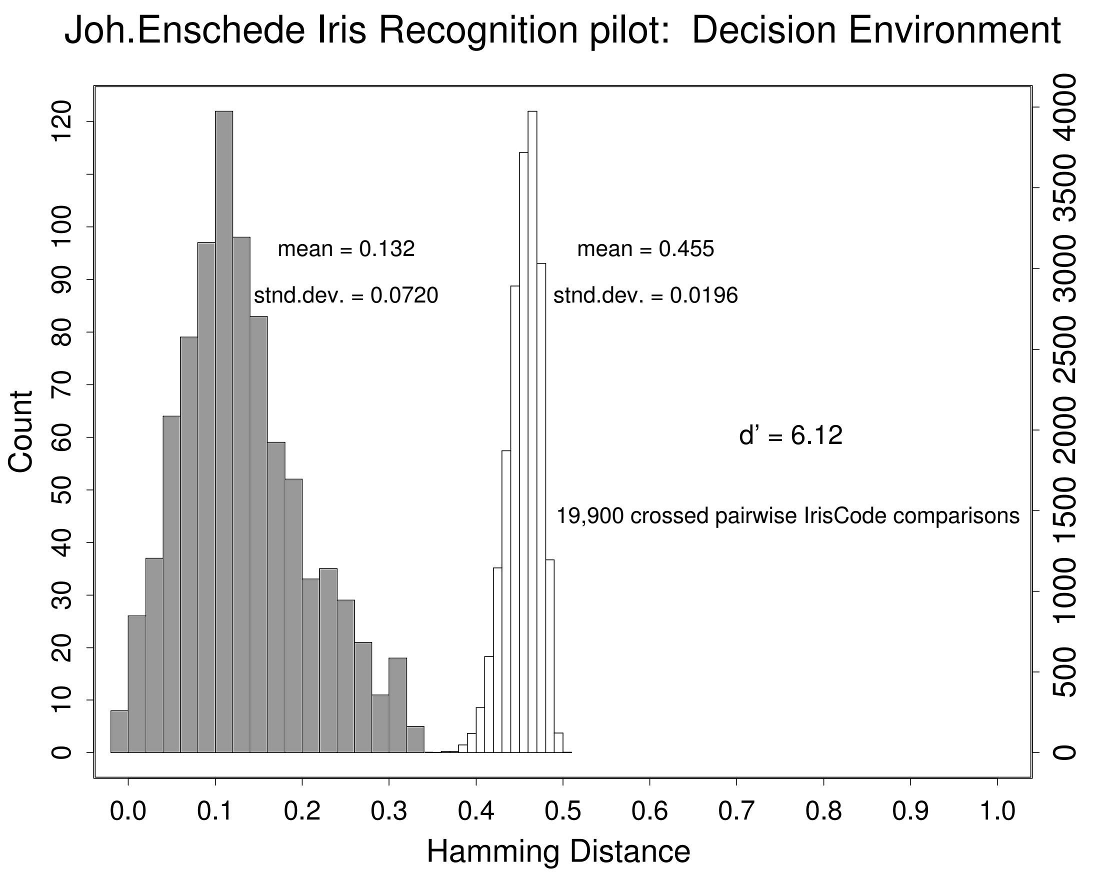
(6) National Physical Laboratory, UK, CESG contract X92A/4009309 (2001), *Biometric Product Testing Final Report.* Available on-line at `http://www.cesg.gov.uk/technology/biometrics` For comparisons against 8 competing biometrics, see Figure 6, page 12 of the NPL report.

(7) J. Daugman (2003), "The importance of being random: Statistical principles of iris recognition," *Pattern Recognition,* vol. 36, no. 2, pp. 279-291.

(8) J. Cambier (2003), "Iridian Cross-Comparison Test," Technical Report TR-02-004.

Independent Test Results by British Telecom and Joh.Enschedé



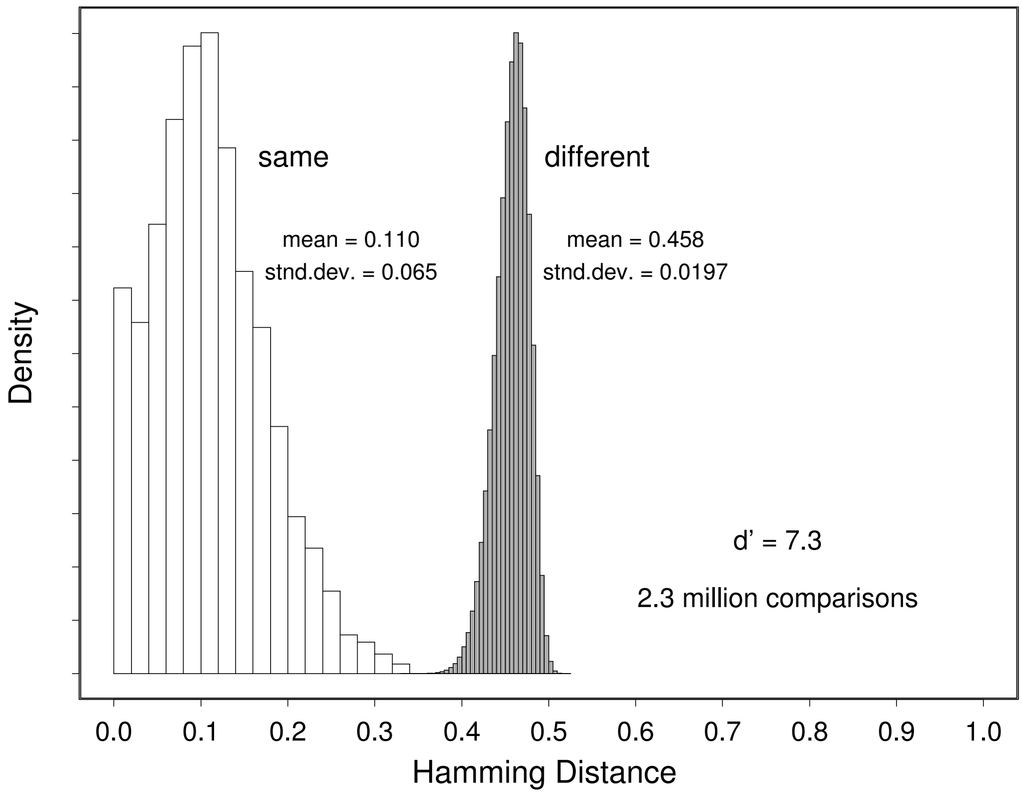


Dependence of False Reject Rate on Imaging Platform

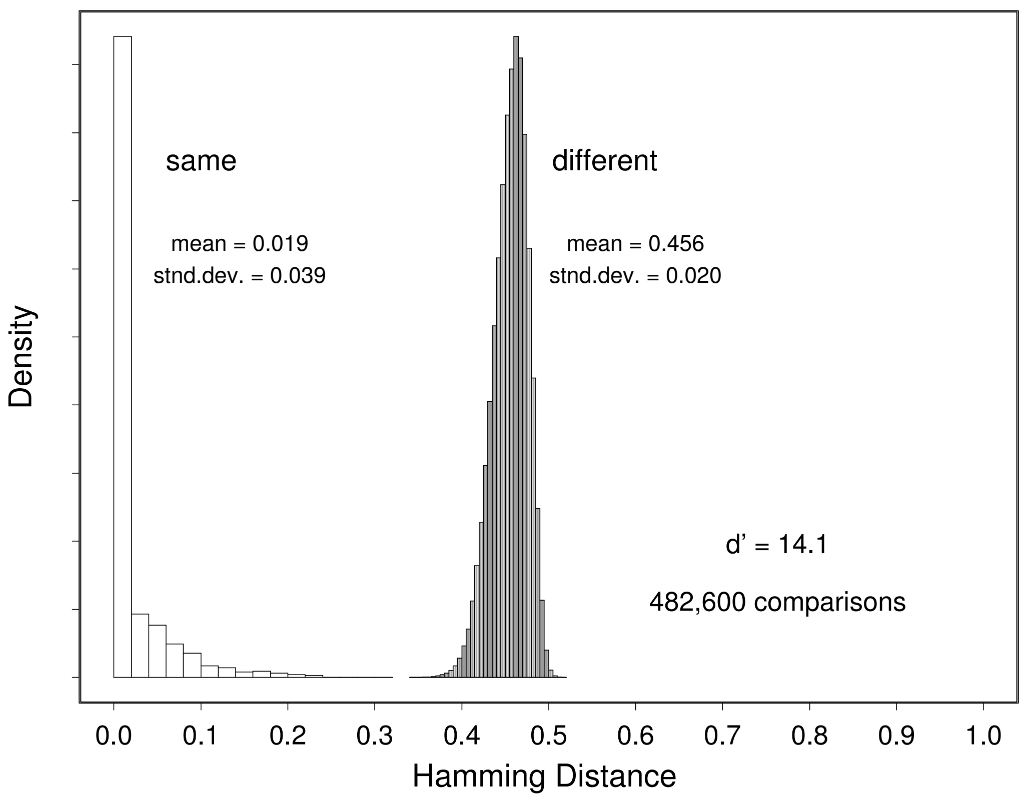
The following two graphs show the difference between ideal and non-ideal imaging conditions. Conditions do not affect the "Impostors" distribution, but only the "Authentics" distribution.

The National Physical Laboratory trial conditions should be described as favourable, if not quite ideal. The reported False Reject (False non-Match) Rate was 1.9% on the first attempt, falling to 0.2% by the third attempt. There were no False Matches made in 2.73 million comparisons.

Decision Environment for Iris Recognition: Non-Ideal Imaging

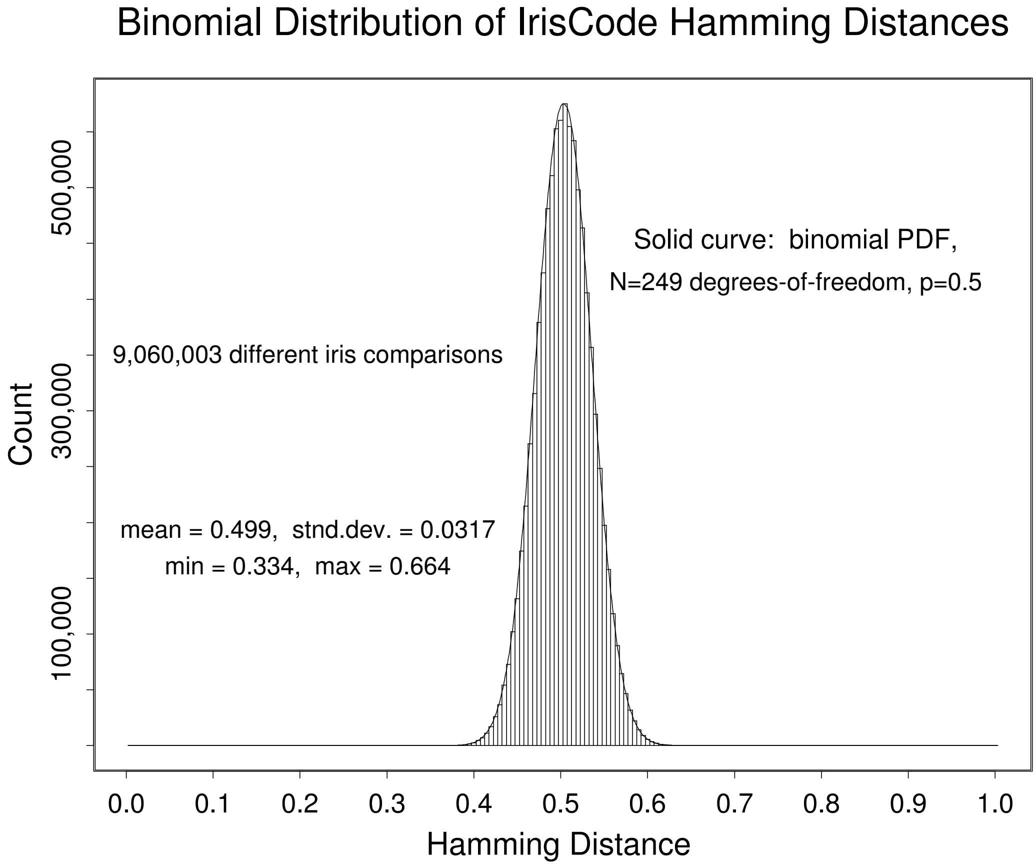


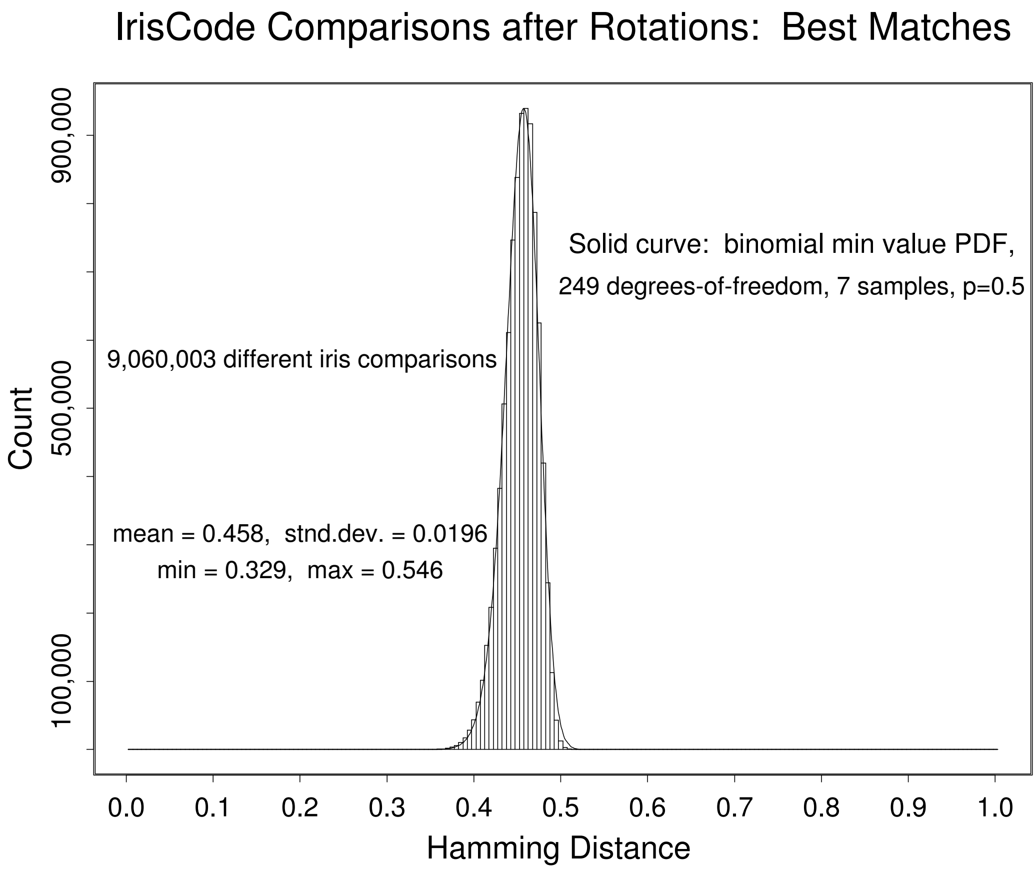
Decision Environment for Iris Recognition: Ideal Imaging

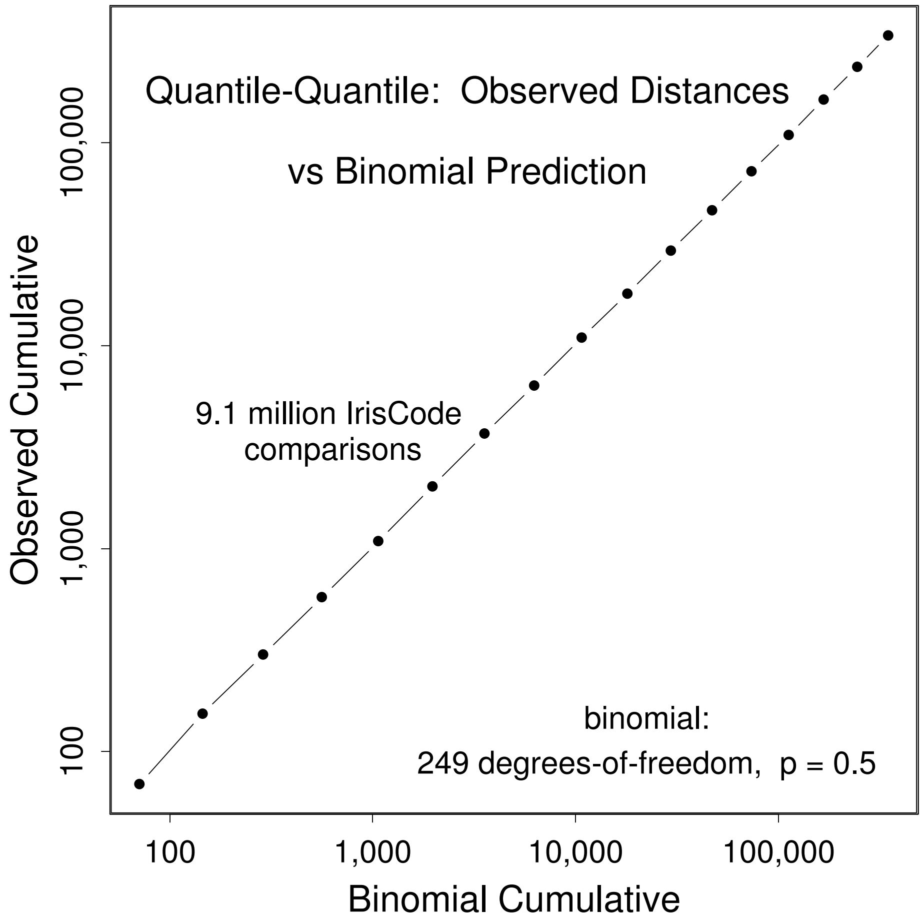


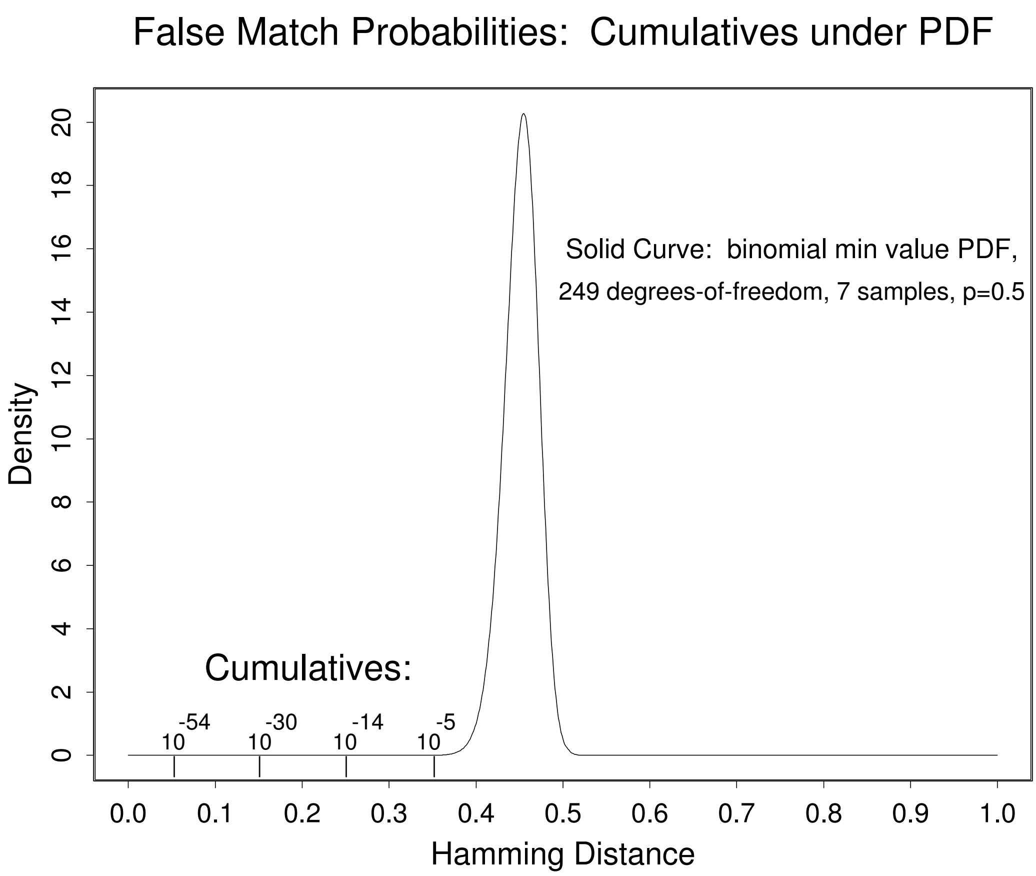
Results from 9.1 million IrisCode Comparisons

The solid curves superimposed on the distributions are (a) a pure binomial with 249 degrees-of-freedom; and (b) the extreme-value distribution resulting from repeated sampling from the same binomial (representing the effect of rotations to seek matches in different orientations).






Quantile-Quantile: Observed Distances
vs Binomial Prediction
9.1 million IrisCode comparisons
binomial:
249 degrees-of-freedom, p = 0.5
Observed Cumulative
100
1,000
10,000
100,000
Binomial Cumulative


False Match Probabilities: Cumulatives under PDF
Solid Curve: binomial min value PDF,
249 degrees-of-freedom, 7 samples, p=0.5
Cumulatives:
10^{-54}
10^{-30}
10^{-14}
10^{-5}
Density
Hamming Distance
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

False Match Probabilities as a Function of Decision Threshold

The IrisCode search engines employ an adaptive decision criterion set to 0.32 for single verifications, but declining as a function of search database size so that net False Match probability does not increase when searching larger databases as it does for other biometrics.

HD Criterion	*Odds of False Match*
0.26	1 in 10^{13}
0.27	1 in 10^{12}
0.28	1 in 10^{11}
0.29	1 in 13 billion
0.30	1 in 1.5 billion
0.31	1 in 185 million
0.32	1 in 26 million
0.33	1 in 4 million
0.34	1 in 690,000
0.35	1 in 133,000
0.36	1 in 28,000
0.37	1 in 6,750
0.38	1 in 1,780
0.39	1 in 520
0.40	1 in 170