COMPACTING PROFESSOR ACKERMANN

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On the occasion of this memorable birthday of Professor Ackermann we offered to store his profile in a compact computer readable format, easily accessible and reconstructible for future generations.

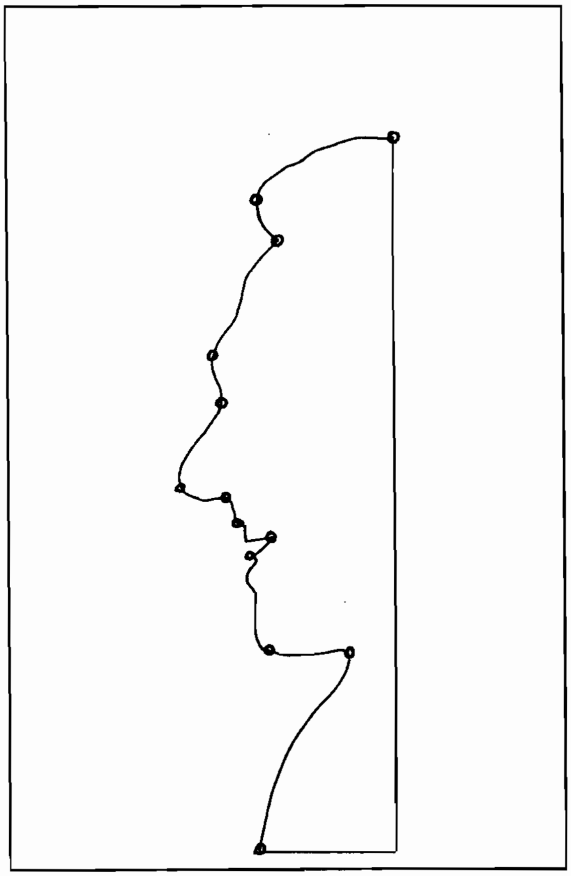

Figure 1

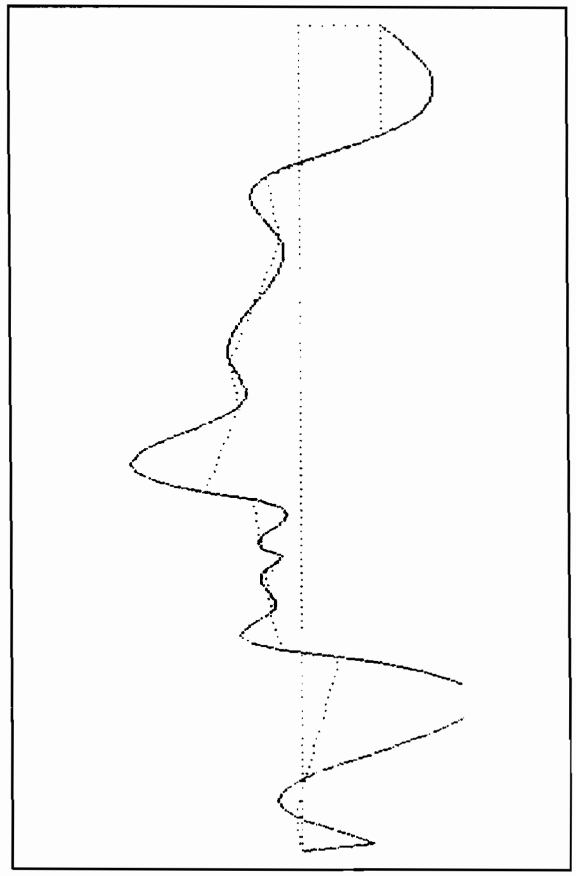

Figure 2

To that purpose we selected as a first try 15 characteristic points of Professor Ackermann's profile (Figure 1) and computed through these a cubic spline (Figure 2), the same which Professor Ackermann himself studied in his dissertation for strip adjustment. You surely agree that this is not the way to proceed. We see here all the negative effects of a cubic spline, which minimizes the curvature (or more appropriately the sum of squares of the second derivatives) and thus rounds all the edges.

One way around our dilemma is to introduce breakpoints and curvature points, like in programs such as SCOP, but this would unnecessarily increase the number of points to be stored, and the ease of reconstruction. No, we really look for an elegant way of compact preservation, without the use of breakpoints.

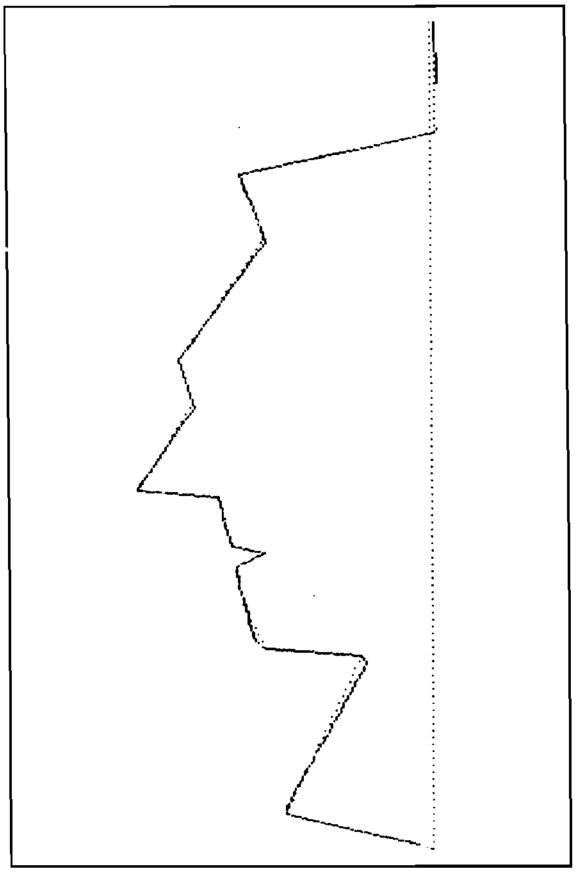

Figure 3

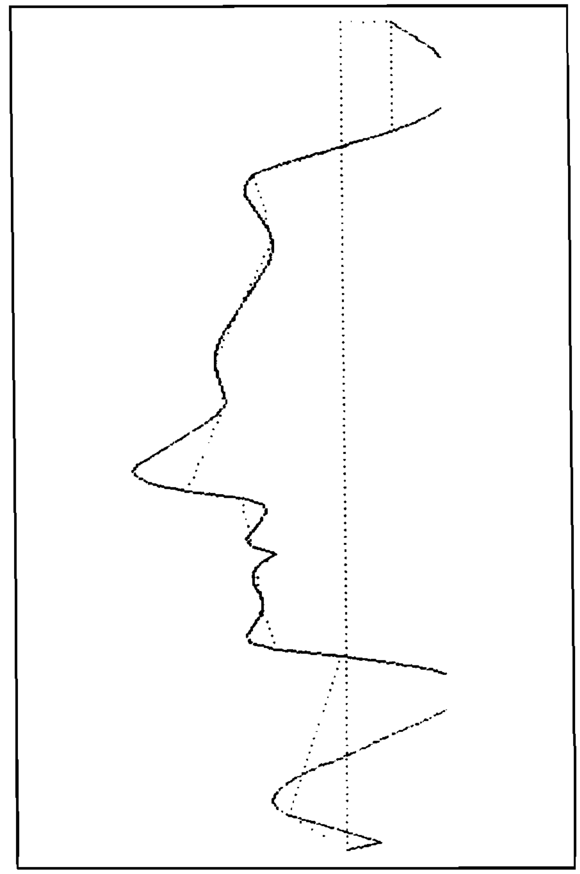

Figure 4

L_1 approximation, or minimizing the sum of (first powers of) the curvatures,

$$\int \text{abs}\left(\frac{\partial^2 y}{\partial x^2} \right) dx \longrightarrow \min$$

may be a solution, but then Professor Ackermann appears very edgy. So we tried it with Lp approximation, minimizing the p-th power of the curvature (see Kubik, 1987), with p = 1.6 in Figure 4. Not yet the ideal result.

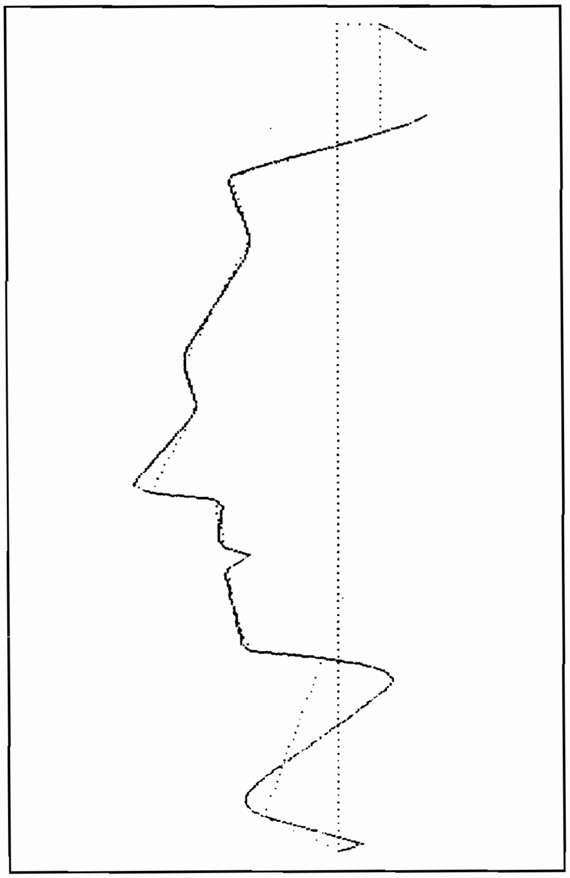

Figure 5

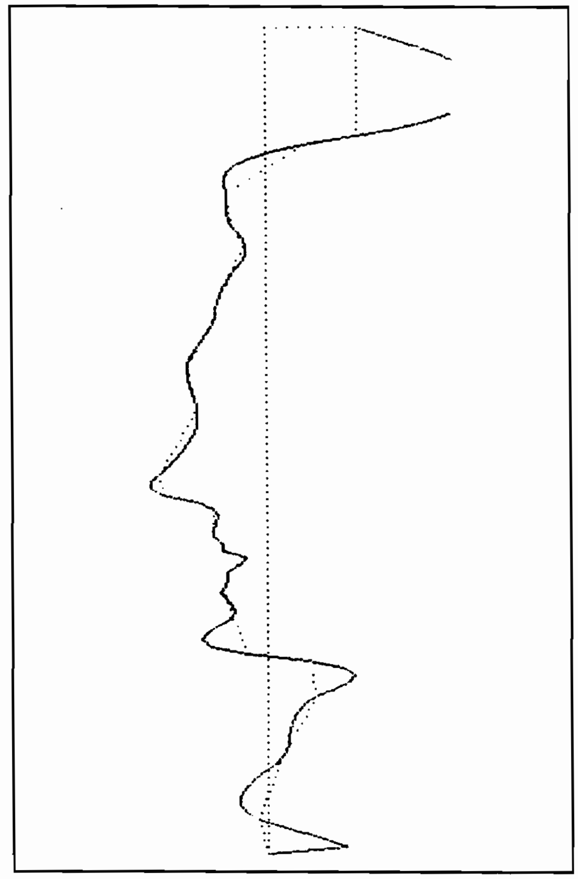

Figure 6

Minimizing the 1.4^{th} power of the curvature, came closer to Professor Ackermann's profile, although his nose is still too pronounced. It just wouldn't work with 15 points.

We took the decision to allow more points to be stored. After some experimentation we settled at 27 points. A cubic spline approximation through these points is now already much more reliable, which increased our hopes.

Oops, too close to an L_1 approximation again (Figure 7), so back to the computer screen. A $L_{1.4}$ approximation of Professor Ackermann now looks already really promising.

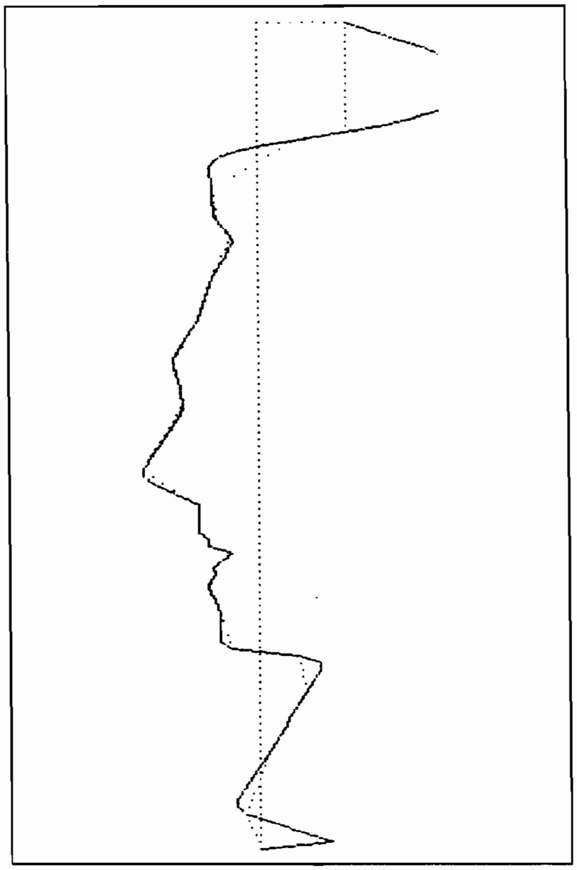

Figure 7

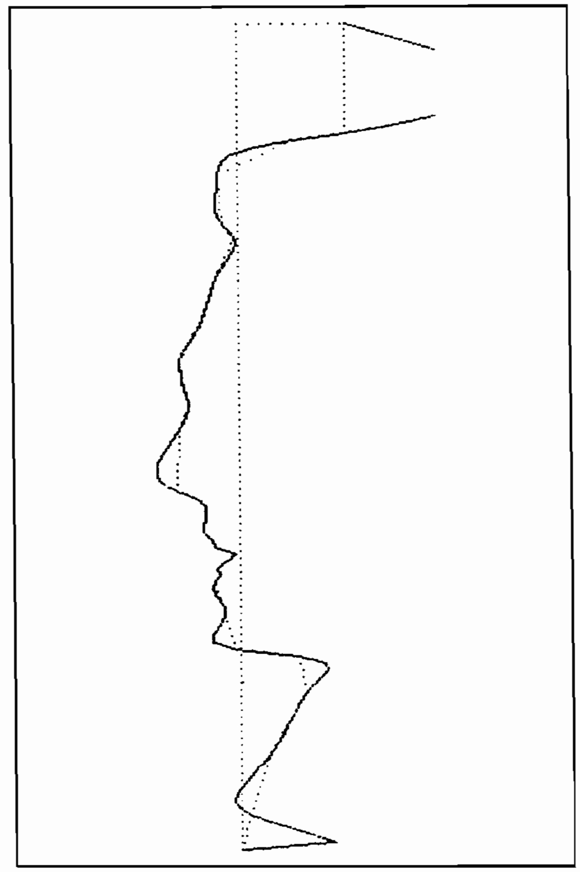

Figure 8

That's when we decided to use the robust Danish Method propagated by Kubik (Kubik,1985), and which is also so successfully used for Blunder detection in Photogrammetric Block adjustment PAT-MR and in many other areas.

This gives the result we all want to see: A compact storage of Professor Ackermann with 27 data point only, no break points and approximating the true shape to 0.2 of a millimeter. In enclosure 1 we include the program listing for you to reconstruct Professor Ackermann.

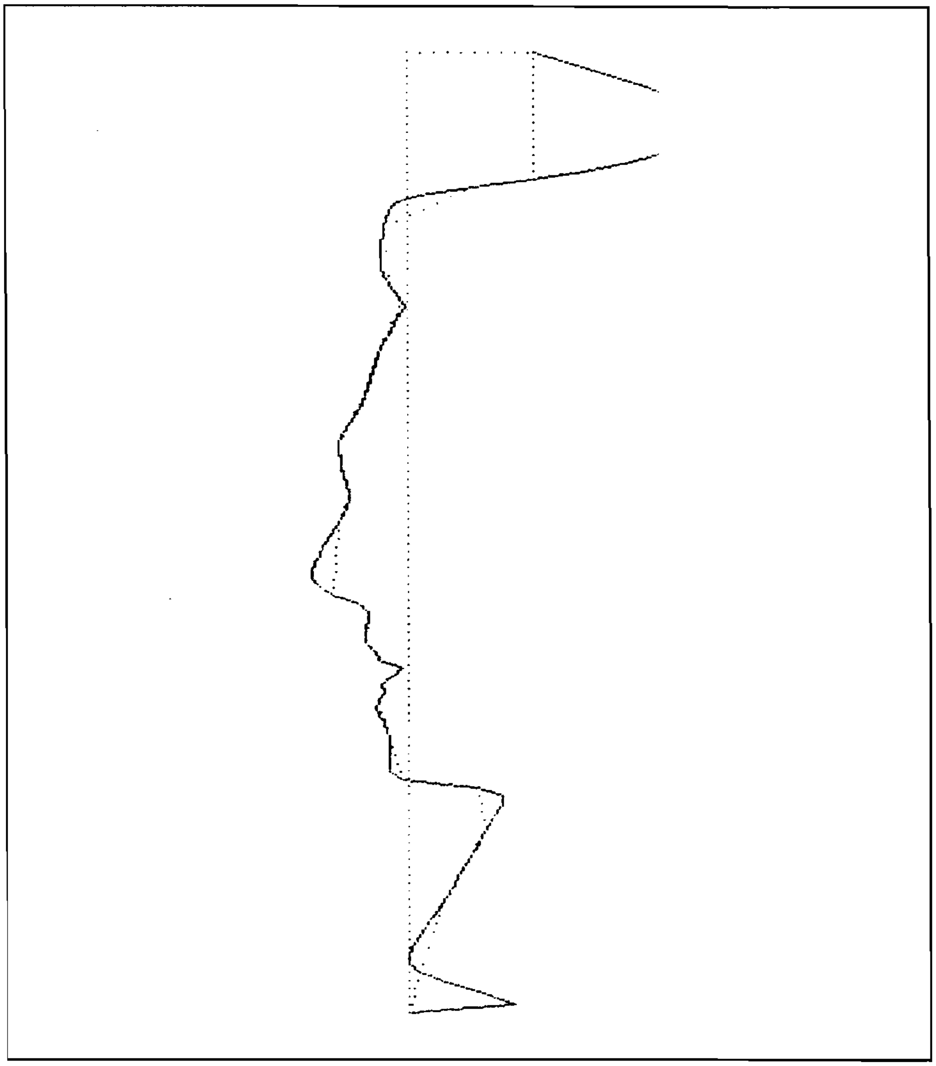

Figure 9

Congratulations, Professor Ackermann!

References:

Kubik K, co-authors T Krarup and J Juhl, 1980, "Gotterdammerung Over Least Squares Adjustment". Presented paper Comm III; Proceedings 15th Congress of the International Society of Photogrammetry.

Kubik K, 1983. "The Danish Method; Experience and Philosophy", Deutsche Geod Komm Reihe A 98, pp 131-134.

Kubik K, co-authors W Weng and P Frederiksen, 1985. "Oh, Grosserrorors", The Australian Journal of Geodesy, Photogrammetry and Surveying, No 42, pp 1-18.

Kubik K, co-authors P Frederiksen, W Weng, 1985. "Ah, Robust Estimation", The Australian Journal of Geodesy, Photogrammetry and Surveying, No 42, pp 19-32.

Kubik K, 1987. "Digital Elevation Models - Review and Outlook", Proceedings of the American Society of Photogrammetry and Remote Sensing, Baltimore.

Enclosure 1

Program Listing for the Compact Storage of Professor Ackermann's Profile

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Data;	Residuals V(i) by rows				
2.85,	.46,	.00,	.00,	-.11,	-.1.80,
-1.68,	-.37,	-.02,	.00,	.00,	.00,
.00,	.00,	.00,	.00,	.00,	.00,
.00,	.00,	.00,	.00,	.00,	.00,
.00,	.00,	.10,	4.64,	5.93,	-9.59,
-.09,	.01,	.01,	.00,	.16,	.02,
.00,	-.05,	-.97,	.01,	.74,	-1.74,
.00,	5.00,	-3.40,	1.40,	-1.49,	-.07,
.00,	.07,	1.49,	1.50,	-.64,	-1.36,
-1.26,	-.30,	-.03,	.00,	.00,	.00,
.00,	.00,	.00,	.27,	.40,	.17,
.03,	.00,	.00,	.00,	-.15,	-.75
-.02	.00,	.00,	.01,	.12,	.14,
.02,	.00,	.00,	.00,	-.04,	-.23,
-.02,	.00,	.00,	.00,	1.19,	.34,
.00,	-.23,	-.25,	-.26,	-.21,	-.10,
-.02,	.00,	.00,	-.01,	-.27,	-2.93,
-4.42,	-.58,	1.44,	1.35,	1.26,	1.17,
1.08,	.99,	.89,	.81,	.72,	.63,

Then construct the profile heights from

```
H (1)  = V(1)
H1 (1) = V(1)
DO 170   I = 2, 120
     H (I) = H (I-1) + V (I)
     H1 (I)= H1 (I-1) + H (I)
170  CONTINUE
```

output heights to screen and/or printer.
Obviously these heights must be scaled in some way, as not all computers will give the same compact representation of Professor Ackermann.