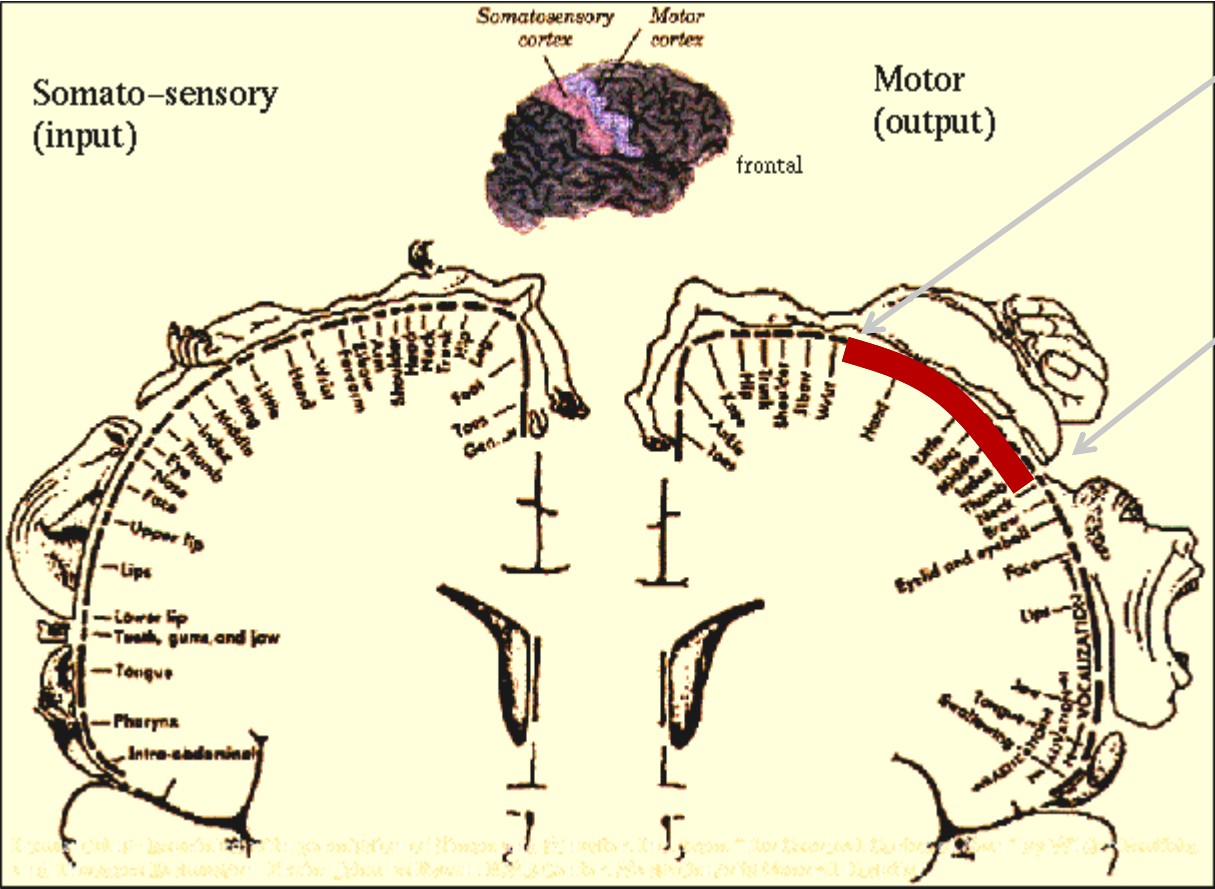# The future of handwriting recognition

Lambert Schomaker – chair

Introductory slides for the panel session at the International Conference on Frontiers in Handwriting Recognition, Bari, 18-9-2012. *Post-hoc annotated.*

Handwriting

› An acquired skill

› For persistent storage of information;

- Directed at other persons;

- Directed at self;

› Exploiting the biomechanical versatility of the writing hand;

› Exploiting the fact that the brain has reserved many neurons to the hand system.

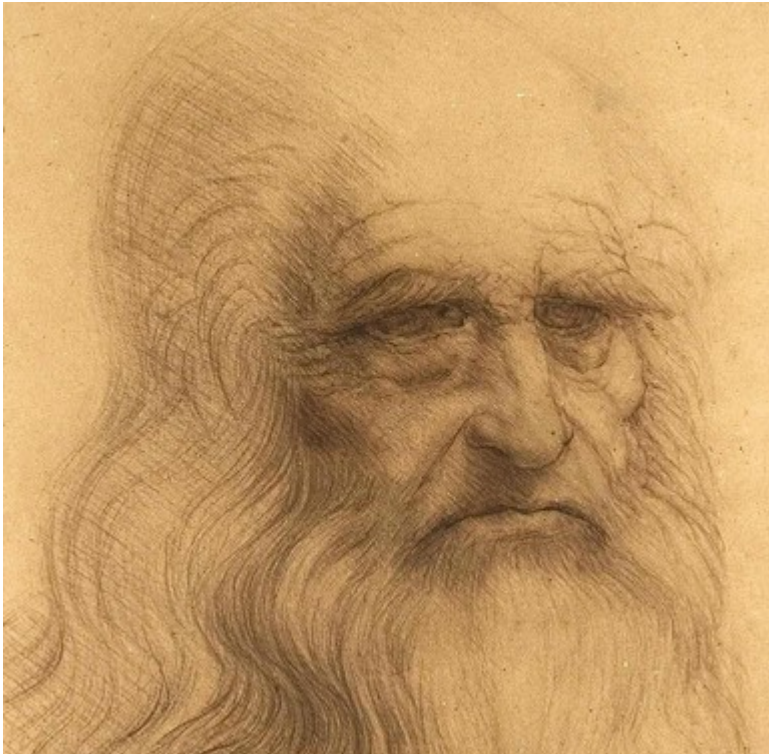# Cortical regions devoted to movement

After the classical figure by:
Penfield, W. & Rasmussen, T.
(1950). *The Cerebral Cortex of
Man*. Macmillan, New York.

ICFHR 2012 – panel discussion

Writing ...   and   drawing skills

i.e., **many bits** !!

Therefore:

› It would not be wise
to neglect the existing advantage of a
high-resolution positional control system,
with a high signal to noise ratio:

› The Writing/Drawing Hand

Trends

› We write less and less

› We swipe more and more on tablets

› But stylus-based systems keep coming

› And historical documents are not walking away

› The need for accurate interactive input increases on small devices

Issue 1. Science

› Is anything fundamentally solved yet?

› Are we guilty of 'experimental programming' ?
(Edsger Dijkstra)

› Is the base literature actually read?

› Do *you* know how digitizers and CCDs work?

› Linear pipeline factory
vs dynamic constraint satisfaction
(read: **existing insights are not used**)

Issue 2. Image processing

› Foreground / background separation solved?

› Why do we need that anyway?

› Who uses color features?

› Layout modeling solved?

Issue 3. The overfit

```
i=1;
while(true)
{
    pick_one_book(number=i, style==S,language==L);
    hire_one_PhD();
    wait_four_years();
    ➔ 95% accuracy;
    ++i;
}
```

- no generalization in sight?
- highly particular slave labor ?

Issue 4. Writer identification

› Is getting better and better, forensic and paleographic

› But the users want likelihood ratios

› Do you trust your LR?

› What is the reference population?

Issue 5. Language modeling

› Corpora are contemporary texts, newspapers, novels

› How to bootstrap language models for 'new' script styles or old manuscripts?

› How can the system know the applicable corpus model?

Issue 6. Databases

› - galore!
› Multilingual script styles, periods etc.
› How to use them in a meaningful way?
› Can we mix them without problem?
› Benchmark organization

Issue 7: Industry and hardware

› Wright brothers: 1st motorized flight 1903

› War employment of airplanes 1914-1918

› 1920^{ies} – wordwide airplane manufacturing and airlines starting to operate (KLM, 1920)

› HWR: 1966 – uppercase recognition for FORTRAN code sheets

› 2012 ? Where is our industry, apart from postal automation?

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Groner, G.F. (1966) "Real-Time Recognition of Handprinted Text", Memorandum RM-5016-ARPA, The Rand Corporation, October 1966.

Handwriting recognition on RAND tablet: curvature feature, corner detection, endpoints, height, width, center, aspect ratio, position relative to writing baseline (on screen)

Segmentation in handwriting by X overlap, centers, spatial separation

Performance: 20 minutes user practice, information training: **82% to 92%, 81% to 93%, 90% to 96%**, depending on user training/familiarity

User-interface for handwriting recognition/editing of FORTRAN coding forms
53 symbols,

Sampling tablet **at 250 Hz**. Multiple stroke characters were order free

Hardware? Newton, Crosspad, Tablet-PC
Apple iPad (?),
Samsung
Galaxy Note 10.1

will new devices be good enough?

Issues

1. Science
2. Image processing
3. Writer identification
4. Language modeling
5. Databases
6. Industry & hardware

The panel

› Prof. dr. C.Y. Suen

› Prof. dr. B.B. Chaudhuri

› Prof. dr. R. Plamondon

› Prof. dr. S. Impedovo

› Prof. dr. S. Srihari

› Dr. Volker Märgner

› Dr. M. Liwicki

(discussion)

- › *The public selected the item "language modeling"*
- › *The panel selected the item "science"*

- › *Most elucidating outcome:*
  - • *Few, if none of the participants was willing to claim that linguistic modeling helped more than a few percentage points*
  - • *With the exception of address reading, but even there, problems exist. LS. October 2012.*