Nomon: A Flexible, Bayesian Interface for Motor-Impaired Users

Available in Poster sessions P03 and P04 (Thursday)

Nicholas Bonaker
Graduate Student, MIT
nbonaker@mit.edu

Emli-Mari Nel
Head of Research, Empiric Capital
emlimari.nel@gmail.com

Keith Vertanen
Associate Professor, Michigan Tech
vertanen@mtu.edu

Tamara Broderick
Associate Professor, MIT
tbroderick@csail.mit.edu

What Is Nomon?

Nomon is a computer interface for people with **severe motor impairments** and near complete paralysis.

These individuals interact through a **single switch:** some switches activate with blinking, breathing, etc…

Nomon adapts to a user's switch ability and patterns to both **minimize error** and **increase typing speed.** [1]

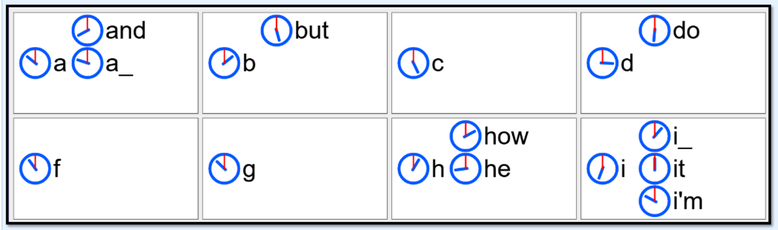

Figure 1: Close up of the Nomon keyboard and its signature clocks

Each option (word predictions or characters) has a clock to its left.

Users select an option by pressing multiple times when the adjacent clock passes noon.

The clock phases change to maximize information gain between each press.

You can demo Nomon at

nomon.csail.mit.edu

Open source code at

github.com/tbroderick/Nomon

How Nomon Works

Nomon uses **Bayesian inference** to adapt its selection criteria to each user.

Each option has a **prior** from the language model.

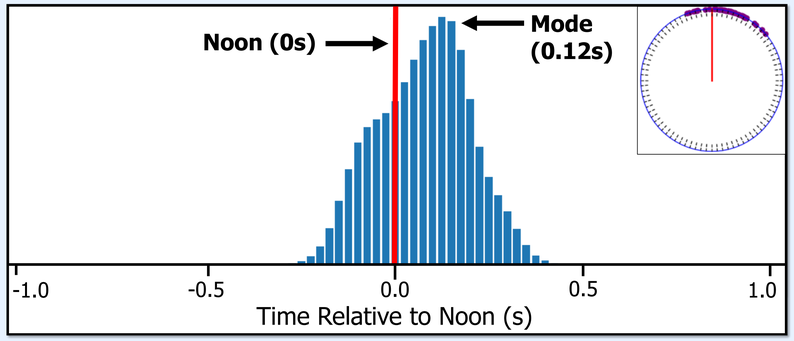

Figure 2: Kernel density estimator (likelihood) from a user's presses

Users rarely press exactly at noon; therefore, Nomon estimates the **likelihood** of where a user will press relative to noon from their previous presses.

After each press, Nomon computes the **posterior distribution** over all options from the prior, likelihood, and observed presses.

If the posterior probability of any option exceeds a threshold, the option is selected.

After selection, the Nomon updates the likelihood estimate with the new press time information (given the winning option).

User Study Results

Longitudinal study following 13 able-bodied participants across 10 sessions that compared Nomon and Row Column Scanning (RCS) systems.

Participants **typed 15% faster** with Nomon in a text entry task, though they had a 10% higher click load (clicks/char).

Participants selected options **35% faster** and **with half as many corrections** using Nomon with a large number of unordered options.

In the final session, participants rated Nomon easier to use than RCS, and 12/13 participants **preferred typing with Nomon.**

Future Work on Nomon

We are currently recruiting for our next **study with motor-impaired users**! *mitkbstudy@gmail.com*

We are developing a **more efficient algorithm** for Nomon based on probabilistic text entry in mobile devices using **hidden Markov models**.

References

[1] Broderick T, MacKay D.J.C. (2009) Fast and Flexible Selection with a Single Switch. PLoS ONE 4(10): e7481. doi:10.1371/journal.pone.0007481