Modelonics

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This page's link: https://ftp.setterholm.com/WorldPeace/Math/Modelonics.pdf

America's tragedy is that its public frames-of-reference and ethics have been desecrated by nonsense & noise. Within the past year the voting majorities among our most senior elected & appointed officials have scorned the nation's two founding frames-of-reference: the U.S. Constitution & the 10 Commandments, and also disregarded the oaths of office. Many valuable frames-of-reference reside in the minds of our civil servants; firing them willy-nilly is senseless.

The shared sense of purpose of America's citizens has collapsed like a house of cards. Our former international allies have learned that Americans are dangerously unpredictable and unethical decision makers. Rigidly holding public officials to their oaths of office with harsh infraction penalties for infractions, and having our laws and their penalties promptly apply uniformly to everyone, would be improvements.

Democrats portray winning the next election as the clear path forward. However, rallying citizens to correct our internal problems at the voting booth failed eight months ago. Based on the damage done since January 2025, perhaps American Ideals will be gone before the November, 2026 election arrives. Failures of our frames-of-reference created our problems. Let's find better ways to govern, now.

Frames-of-reference are models, some models support useful & constructive priorities & actions. Create:

"Modelonics": the science of creating, nurturing, promoting, protecting, and supporting useful and constructive models.

Many complicated pieces of equipment work better than the USA's political process. Companies & people worldwide know enough & care enough to design & build equipment that harmonizes a myriad of functional, enduring components to achieve important, dependable results. An elegant part of that know-how is sensor calibration.

I have many years of experience successfully calibrating cutting-edge sensors for high-tech companies. Nonsense and noise are the victims in a sensor calibration. Reliable data-based signals are the product. A software model becomes the no-nonsense frame-of-reference. The model coefficients fit all of the noise-free test data results almost perfectly. In use, the sensor transforms its input data to a needed, reliable, useful quantitative output using either calibrated hardware components within analog sensors or calibrated equations within digital sensors.

Sensor calibrations in research & development:
A sensor model and its test dataset(s) are interactively modified & reconciled. Noise and nonsense are left behind by improving the model's equations until the model accurately predicts all of the valid test data.

Sensor calibrations in production:
Subsequent mass production calibrations of the sensor reuse the same model, only need one dataset, and routinely compute the calibration coefficients automatically. The calibrated sensor transforms valueless input data into valuable quantitative insight(s).

My calibration guidelines:
1. Start by creating a software model of the device/problem. The objective is to find equations that predict all the valid data points' outputs when the equation coefficients (i.e. variables) have correct values. The equations with their correct coefficient values are the calibration. [Note: the approach described here assumes equation coefficients with continuously variable values.]

2. A single data point is comprised of the set values of each device input and the corresponding observed values of each device output. A dataset with five times more data points than coefficients "over-samples" the model.

> Over-sampling is the key to finding & eliminating both the model's nonsense & the data's noise. Solving many more equations than unknowns (coefficients) with almost no remaining noise yields enlightened discernment, i.e. a robust model, i.e. an enduring, reliable, quantitative, accurate frame-of-reference.

3. Modeling the device requires:
   A. Identifying the inputs and outputs of interest.
   B. Finding candidate equations with adjustable coefficients, which may link the inputs to the outputs.
   C. Gathering a dataset with 5x over-sampling.

4. Computing the least-squares-best-fit of a model to an over-sampled dataset is a solved problem; the model can include non-linear equations, which are far more difficult to solve than linear equations. There is a lot of mathematical detail in realizing these fits, but they will become casually doable without mental effort at the push of a button (like computing sines and cosines on a scientific pocket calculator).

5. in the over-sampled best-fit, noisy data point outputs tend to stand out in disagreement with their input's near-neighbors. Errors in the model equations tend to cause data regions to have larger errors than the average for the dataset.

Improve the equations, remove bad data points, and best-fit again, in an iterative process.

6. Sensor calibration is not naturally intuitive. Develop the intuition:
> Any set of equations can be assigned known coefficients and then exercised to generate a virtual 5x-over-sampled dataset. Call the results “golden equations” & “the golden dataset”, because they’re worth their weight in gold.
>Use 3D visualization (the eyes/brain spatial analyzer) to grasp the shape of the dataset. Equations construct various classes of shapes. What class of shape is likely to fit the data?
>”Guess” what equation shape will fit the golden data. Visualize both the model’s output and the dataset’s best-fit outputs in the same 3D volume. Develop a sense of how various equation errors reveal themselves in model output errors.
>Then add known noise to the golden dataset, and fit the golden equations to the noisy data. Known noise in golden datasets introduces errors in the computed coefficients and also different errors in the output predictions as well, even though the equations are otherwise exact.
>The first datasets of real sensors are mysteries. The golden equations and the golden dataset will have proven that the least-squares-over-sampled-fit is functioning, so noisy data and/or nonsense equations are the actual problem. Error patterns remaining in the many predicted outputs are reality’s unbiased, reliable way of revealing model inadequacies. When the errors are gone, the sensor’s frame-of-reference is established.

Related applied mathematics:

Reference#1:
My introduction to this type of analysis, for linear models, is: “Hyperspace Algebra Tools” , Sep. 14, 2011 54 pages.
https://ftp.setterholm.com/PseudoInverse/Hat.pdf
The paper’s outline on pages 52-54 may be a useful overview.
Forming the pseudoinverse matrix, which condenses the 5x over-sampled data, is realized in eight lines of Basic on page 41.
Page 7 mentions that some coefficients of some high school algebra equations are partial derivatives, and that all the coefficient values in their matrix formulation are numerical partial derivatives.

Reference#2: My high-level linear & non-linear model calibrator:
“Tweak-Engine” , is introduced on my website at link:
https://setterholm.com/2018/10/
All of the Fortran95 syntax-color-coded source code is in:
https://ftp.setterholm.com/Tweak-Engine/ColorCodedSource-pdf
The particular device/problem model is coded into: “Tweak-User.f95” and subsequently exercised by the Tweak-Engine.exe application.
I have not yet written a concise summary of the algorithms.

Many comments are included in the source code, including detailed information about the key variables.
“Tweaking” alludes to making small changes in coefficients’ values to compute their numerical partial derivatives for all the output/coefficient pairs. Coefficient Numerical partial derivatives, inverted, transform output errors into the direction in which coefficient value changes will improve the model’s fit of the dataset.

Reference#3: This paradigm is very different from Modelonics.
“Min-Steps.pdf” teaches how to solve a purely cooperative game in the absolute fewest number of moves – the 2x2x2 Rubik’s Cube. All 3,674,159 valid scrambles are resolved in 14-or-less 90 degree rotations. The link to the paper is:
https://ftp.setterholm.com/WorldPeace/Math/Rubik/Min-Steps.pdf 16 pages.
“Achieving total cooperation with no wasted effort” improves the definition of “being wise”.
Compared to Min-Steps, “just counting votes” resembles “poke and hope”.

Reference#4: The fruit of the effort described in Reference#3:
“WisdomCAD” is a conceptual environment for extremely efficient social decision making, broader in scope than “Modelism”. See:
https://setterholm.com/wisdomcad-jan-28-2025/
The core idea is that Computer Aided Design(CAD) can now embrace Wisdom for the first time – because wisdom has a definition that can be quantified.
Modelonics fits under the WisdomCAD umbrella as a paradigm for creating robust transforms and frames-of-reference.

Reference#5:
“Measuring Social Fairness” provides a scale for quantifying “enough”, as opposed to qualitatively “never having enough”. The Wordparess introduction is:
https://setterholm.com/2017/08/ , and the two-page paper is:
https://ftp.setterholm.com/WorldPeace/Math/MeasuringSocialFairness.pdf

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