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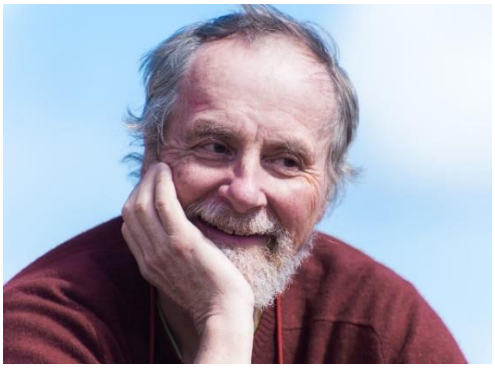
Measurements and Models in Metallurgy: An Integrative Perspective

Prof. Harald Martens, NTNU Cybernetics and Idletechs AS



Harald Martens (71) has published several hundred research papers on multi-channel measurements and data analysis methods. His main focus is on bridging the problematic "math gap" in society at large, and on developing tools for people in industry and academia to utilize their torrents of measured data efficiently and safely, in light of their prior knowledge.

He is the founder and research director in the IT company Idletechs AS (www.idletechs.com). This company produces methods and software for engineers and operators for on-the-fly interpretation of otherwise overwhelming high-dimensional streams of industrial measurements, e.g. in metallurgy. Such data may come from a combination of highly informative and relatively inexpensive, but non-selective sensors – accelerometers / microphones, thermal and hyperspectral cameras, radars and lasers, spectrophotometers, chromatographs etc., - from process or laboratory. He is also an external professor at the Department of Engineering Cybernetics at the Norwegian U. of Science and Technology (NTNU) Trondheim Norway (https://www.ntnu.edu/itk), where he and his colleagues develop the field of "Big Data Cybernetics".

Martens thus works in the new field of "explainable AI", pragmatically combining high-dimensional technical measurements in the domains of time, space and across measurement channels, for monitoring, controlling and optimizing complex systems. Models of known causalities are fitted to the high-dimensional streams of process data to quantify **known process variations**, while the stream of lack-of-fit residuals is assessed for remaining inter-channel correlations, which reveals and quantifies **unknown process variations**. This can give the engineers better control, more complete understanding and fewer, but more sensitive error warnings.

Originally a chemist and food scientist, he holds a Doctor of Technology in chemometrics/physical chemistry from NTNU. He started his career in "multivariate soft data-modelling" back in 1972, when he discovered that his chemical analyzers produced far more data than he and his colleagues had the capacity to interpret, mentally. His early interest in selectivity enhancement in 1981 led to the development of the Do-It-Yourself data analysis package The Unscrambler (http://www.camo.com/rt/Products/Unscrambler/unscrambler.html) and in 1989 to the book Multivariate Calibration (Martens & Næs, Wiley; https://www.amazon.com/Multivariate-Calibration-Harald-Martens/dp/0471930474), both concerning how to convert high-speed multichannel measurements from *per se* meaningless, non-selective raw data into rapid, relevant and reliable quantifications. Later, his interests turned to quantitative, measurement of Quality, as seen both from a technical and a human perspective (see Multivariate Analysis of Quality. An Introduction, Martens & Martens 2001, Wiley; https://www.wiley.com/en-no/Multivariate+Analysis+of+Quality:+An+Introduction-p-9780471974284).

During his 46 years career, he has worked as research scientist and professor in mathematizing subjects in a number of disciplines and in a number of universities and companies around the world. His participation in developing the Partial Least Squares (PLS) regression and the Multiplicative Signal Correction (MSC) for real-world use of multichannel data are among the most cited. In total, his data analysis papers have now been cited over 20 000 times.