# Real-world modelling and scientist personality types

Harald Martens, dr.techn. Prof. II; Dept. Engineering Cybernetics, Norwegian U. of Science and Technology, Trondheim Norway / CEO, IDLETechs AS

http://scholar.google.com/citations?user=60HNWsYAAAAJ&hl=da

- 1. The math gap in biomedical sciences: why, and what can be done?
- 2. Different science cultures: Induction vs Deduction
- 3. The Beluzov-Zhabotinsky reaction as a reproducable metaphor of life?

### Content

- Are Theoretically personality types less creative than others?
- Ontology, technology, data modelling and model modelling
- Changes in math teaching to non-math students?

### Friday 29 May

#### 08.30-10.20

**Prof. Harald Martens** Dept. Engineering Cybernetics, NTNU, Trondheim

CEO IDLETechs AS

"Different personality types in different profession-cultures: Dire consequences for math- & stat didactics and for science at large!"

Prof. Solve Sæbø, NMBU, Ås, Norway

"Students in academia are different. Who do we talk to? An empirical study from NMBU"

#### Prof. Harald Martens,

"How can we reach out to the creative entrepreneur types with our statistics, mathematics and physics education?"

Questions & discussion

10.40-12.30

### Hypothesis: People who work theoretically are less creative than others



Negative correlation, r=-0.02 p(r=0)=0.37, i.e. not significant

Journalists: «No relationship between theoretical work and creativity» WRONG !!

> N=250 Norwegian adults, From Helge Brovold's PhD on personality types and math teaching 2014

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The true effect may be as strong as -0.14 or + 0.1

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Journalists: «No relationship between theoretical work and creativity» WRONG !! r +/- 95% conficence limit, standard OLS

The true effect may be as strong as -0.14 or + 0.1 1000 random sampling of 250 people



Distribution of r(theoretical work, creative)

Confirms: estimated effect is uncertain, even with N=250

N=250 Norwegian adults, From Helge Brovold's PhD on personality types and math teaching 2014 Erroneous use of statistics: 'Significant' and 'not significant':

### Hypothesis: People who work theoretically are less creative than others



Erroneous use of statistics: 'Significant' and 'not significant':

## Hypothesis: People who work theoretically are less creative than others N=ALL 2200 Norwegian adults tested,



May conclude:

A HIGHLY SIGNIFICANT, POSITIVE correlation between Working Theoretically and being Creative! But very small effect: Only 0.5 % of total variance??? Irrelevant! Better conclusion: People working theoretically: Both creative and non-creative!

And some non-theoretical are also very creative.

Erroneous use of statistics: 'Significant' and 'not significant':

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#### **Technical work**

### N=ALL 2200 norwegian adults tested,



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## Personality types and work types are correlated



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Ontology: position and intensity variation in time, space and properties



Epistemology: measure position and intensity variation in time, space and properties, and extract interpretable essence by data modelling



Prototype of future's highdimensional spatiotemporal instrumentation:

Hyperspectral NIR video

1-2 GB of data/hr



### How to deal with Quantitative Big Data

- More disk storage:
- Black box modelling with ANN, SVM etc:
- Mechanistic modelling:
- Cybernetic process model adaptation:
- Combine prior knowledge and massive amounts of measurements!

NOT THE ANSWER

NOT THE ANSWER

NOT THE ANSWER

NOT THE ANSWER

- Prior knowledge. Metamodelling of mechanistic mathematical models
- Measurements: Subspace analysis of data(The Unscrambler etc!)
- Forever learning from on-going processes: OnTheFlyCompression

Epistemology: measure position and intensity variation in time, space and properties, and extract interpretable essence by data modelling



Prototype of future's highdimensional spatiotemporal instrumentation:

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From questions to answers

### **Different science cultures:** Induction vs Deduction









Principal Component Analysis (PCA) of children's body parts 100 body parts measured in 1000 children:



Bilinear structure model:

 $X = x_0 + TP' + E$ 

Principal Component Analysis (PCA) of children's body parts Bilinear structure model:  $X = x_0 + TP' + E$ 



### Hypothetical data

### Bilinear model structure for Partial Least Squares Regression







## Non-linear data-driven ODE development, e.g. in bilinear Scores



The Estimated Jacobian B of a dynamic system, changing over the state space:

Low-rank regression coefficients from PLSR of rates Y vs states X (20 nominal 0/1 state variables for each of 3 quantitative state variables).

Martens, H, Tøndel K, Tafintseva V, Kohler A, Plahte E, Vik JO, <u>Gjuvsland</u> AB, <u>Omholt</u> SW (2013) PLS-Based Multivariate Metamodeling of Dynamic Systems. <u>New</u> <u>Perspectives in Partial Least Squares and Related</u> <u>Methods</u>. <u>Springer Proceedings in Mathematics &</u> <u>Statistics 56</u>, pp 3-30. DOI 10.1007/978-1-4614-8283-3\_1

Developing nonlinear ODE models from state variable time series data by nominal-level dynamic PLSR.

### Multivariate metamodelling



Modern computer simulation design: 18 parameters, 4 levels of each  $4^{18} \approx 100\ 000\ 000\ 000\ possible\ combinations$  OMBR design, 128 experiments:

RIS					
LLSAN LLSAN					
OOR					
	DAO				
	LAO				
		MA			
		DLI			
			COR		
			000-0		
			BUC		
				DES	
				MEN MEN	
				PRO	
					PLA
					FRO FRO
					OOC-P

Emulating facial biomechanics using multivariate partial least squares surrogate models

Tim Wu<sup>1,\*</sup>, Harald Martens<sup>2</sup>, Peter Hunter<sup>1</sup> Issue and Kumar Mithraratne<sup>1</sup>

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International Journal for Numerical Methods in Biomedical Engineering Early View (Online Version of Record published before inclusion in an issue)

### Computational compaction of a large biological model via multivariate metamodellering



Multivariate metamodel (nonlin. PLSR):

Soft

metamodel Application: Speeding up a model

< 0.01 minute (average)

Bruk sansene i naturvitenskap også!

1. Mønsterdannelse under celle-differensiering



### Bruk sansene i naturvitenskap også! 2. Linje-kurvaturens modellom



Fig. 3. Examples of the curves with high values for Sigmoid, Arc, Heavy, Pliable, Steepness and Stationary phase respectively (from the left to the right, from the top to the bottom). Here the dotted diagonal line is a reference line for the sensory panel. It was decided to have it on the print outs for better visualisation of the curves behaviour with respect to the straight line.

«alle» (41) mulige matematiske modeller av linje-kurvatur ble kjørt på datamaskin, hver under «alle» ulike betingelser







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### Math & stats teaching: RADICAL CHANGES REQUIRED

- Science and Society gets MUCH MORE REAL-WORLD DATA
- Crisis in e.g. biomedical research: too much data, horrible reproducibility
- Students must be prepared to interpret huge data tables
- Students therefore need more MATH. MODELLING and DATA MODELLING
- Crisis in math & stats teaching: students fail math, do not learn data analysis
- Math ability is NOT a reliable measure of intelligence.
- Are math culture(s) still arrogant, powerful, self-serving and self-recruiting?

## Can Introvert Theoreticians teach other personality types?



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