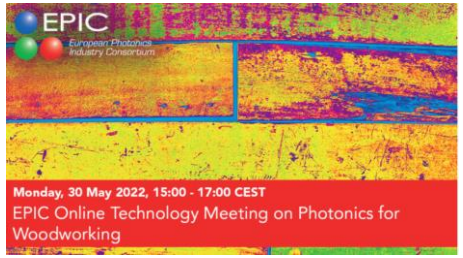


Understanding photonics BIG DATA in Woodworking

Harald Martens

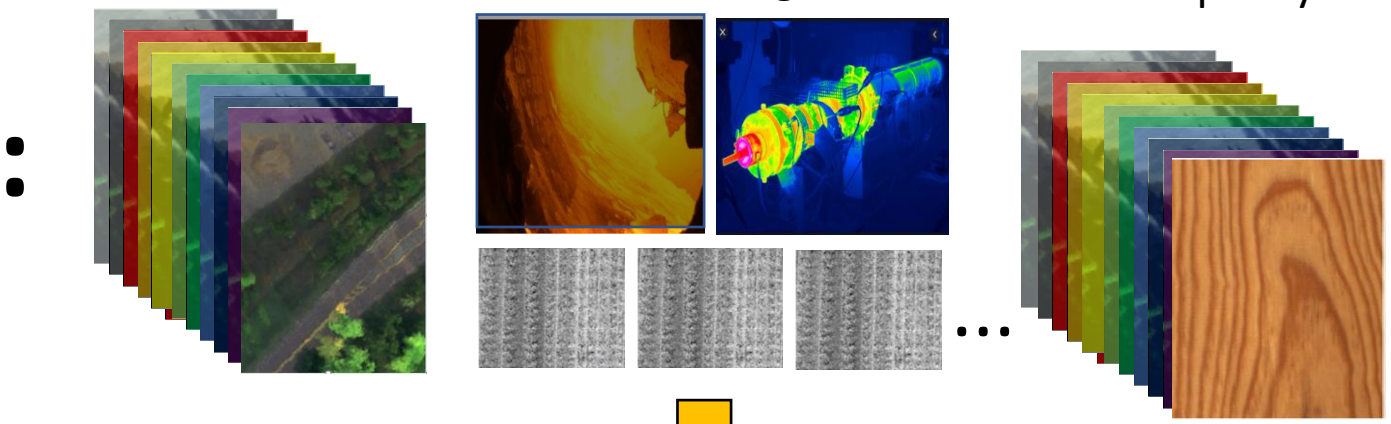
NTNU idletechs

MODERN PHOTONICS:

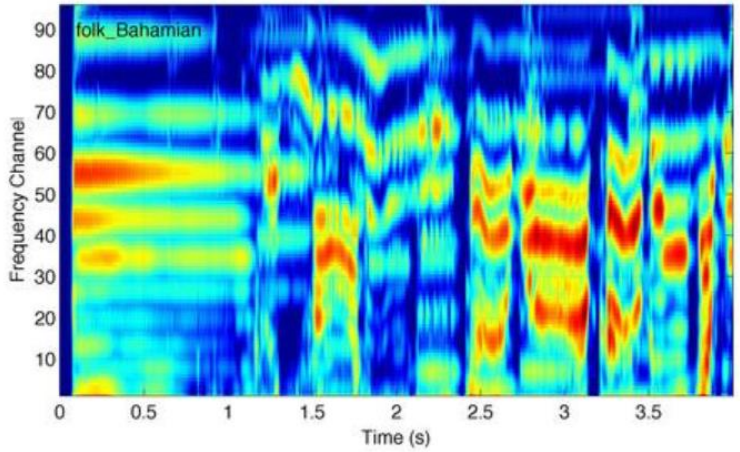
Raw material quality

Processing

Product quality



A cacophony of photonic data



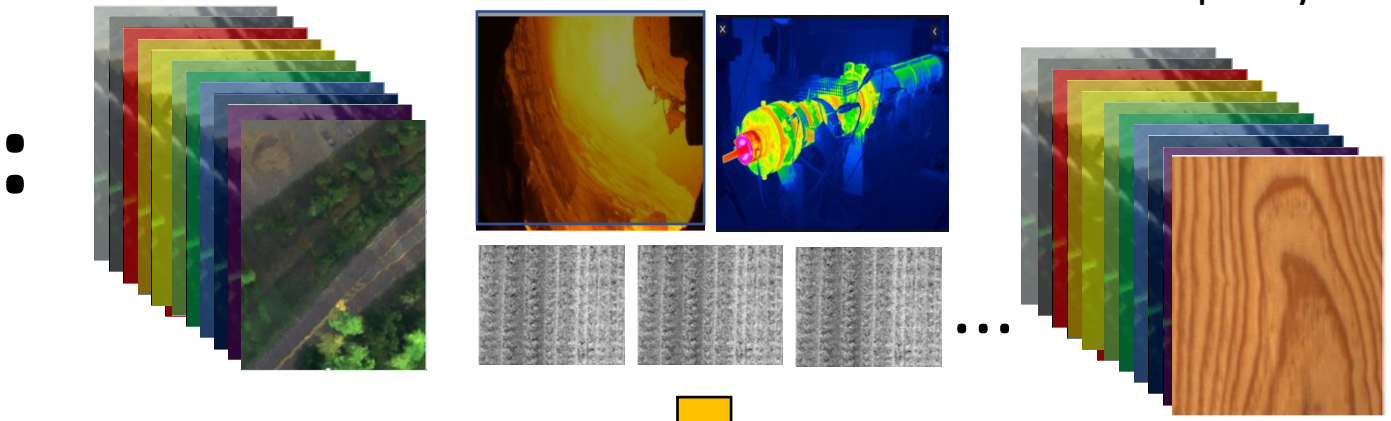
Raw measurements: Overwhelming and non-selective

MODERN PHOTONICS:

Raw material quality

Processing

Product quality

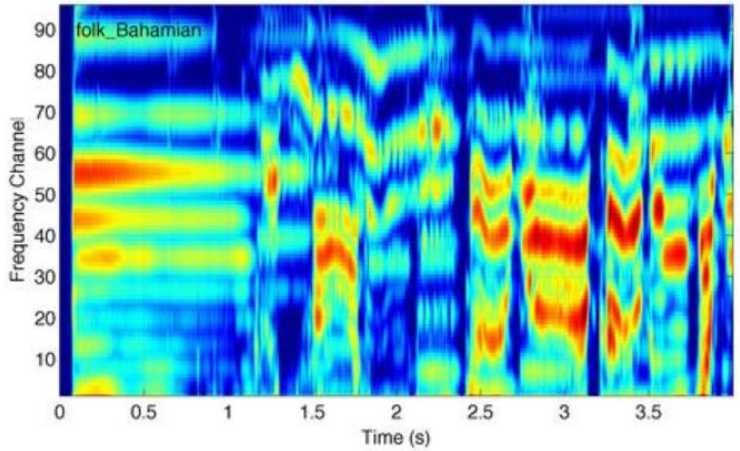


??

Black box
AI

Data
processing

A cacophony of photonic data

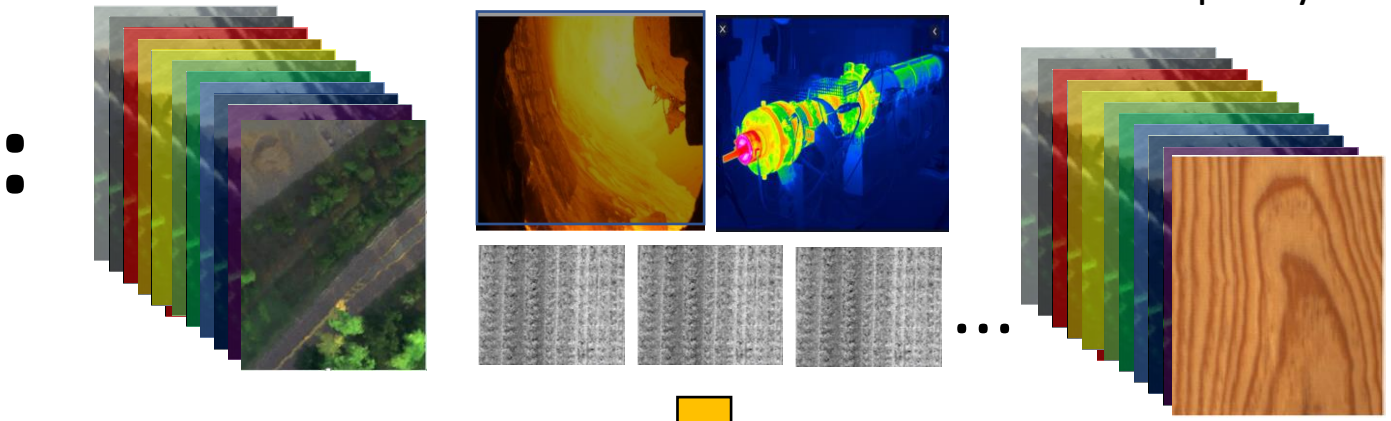


MODERN PHOTONICS:

Raw material quality

Processing

Product quality



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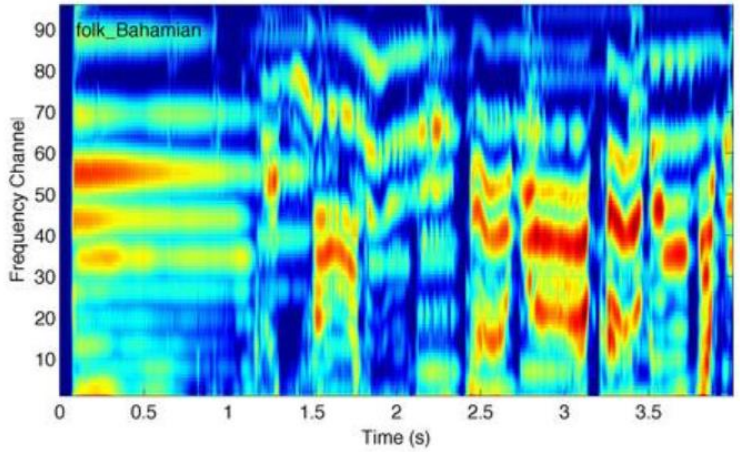
Black box
AI

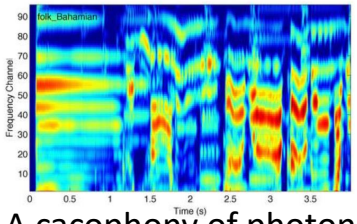
A cacophony of photonic data



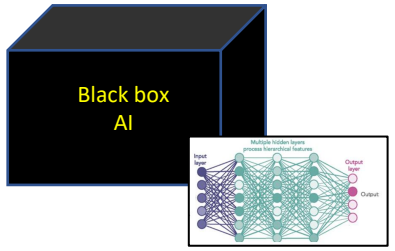
Data processing

Human Perception, Interpretation and Use

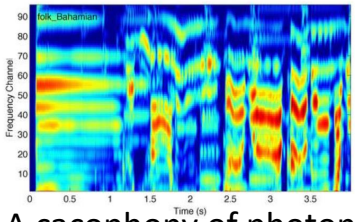
Two data modelling *cultures* for BIG DATA measurements:



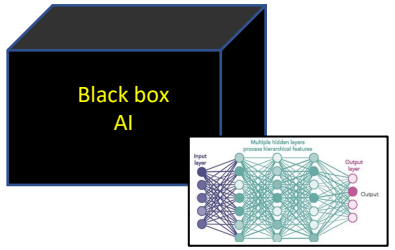
A cacophony of photonic data !

	Data modelling	Starting	Using over time	New insight
	**AI:** Artificial Neural Nets Deep Learning	Too easy	Too difficult	Impossible?

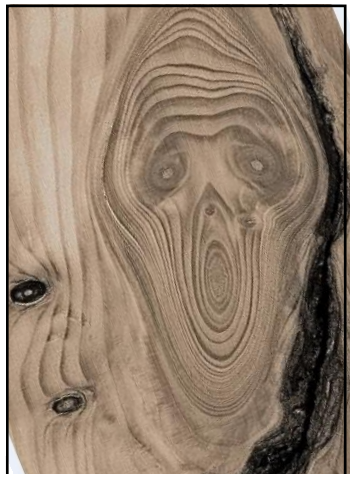
Two data modelling *cultures* for BIG DATA measurements:



A cacophony of photonic data !

	Data modelling	Starting	Using over time	New insight
	**AI:** Artificial Neural Nets Deep Learning	Too easy	Too difficult	Impossible?
	**Musical analysis:** Looking for main harmonies, rhythms	Relatively easy	Relatively easy	Relatively easy

Else Tronstad: Nature’s SCREAM



Else Tronstad: Nature's SCREAM

Edvard Munch: SCREAM

Hyperspectral imaging: λ=1,2,…,200 wavelengths in each pixel

Ingunn Burud, NMBU, Norway

«Musical» data modelling

Harald Martens, Idletechs AS: ***Photonics for Woodworking***

Edvard Munch: SCREAM

Hyperspectral imaging: λ=1,2,…,200 wavelengths in each pixel

Multivariate data modelling

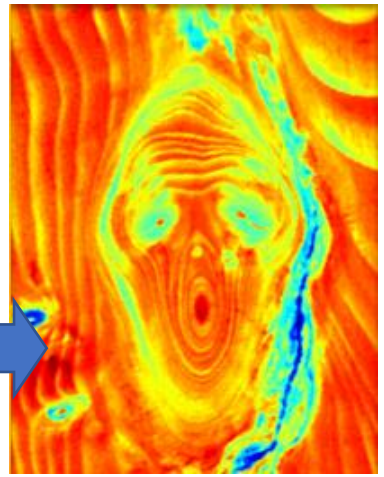
Else Tronstad: Nature's SCREAM

Edvard Munch: SCREAM

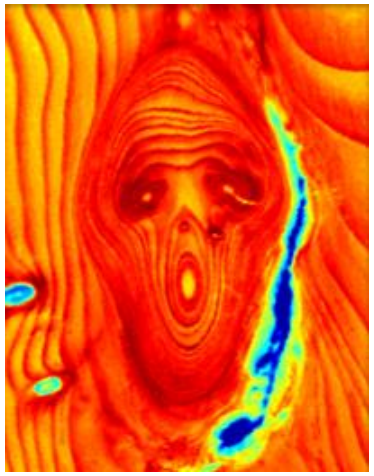
Hyperspectral imaging: λ=1,2,…,200 wavelengths in each pixel

Ingunn Burud, NMBU, Norway

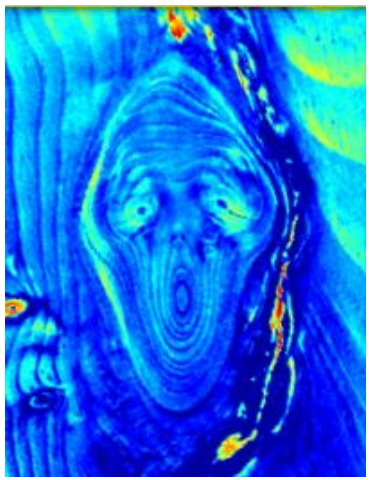
«Musical» data modelling



«Harmony» #1



#2



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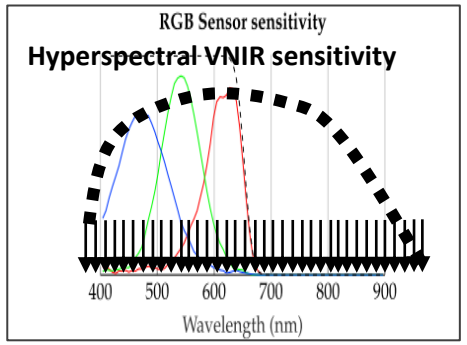
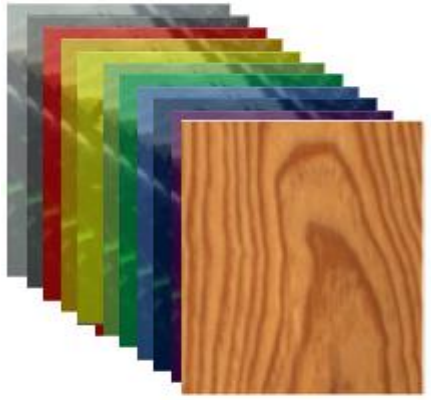
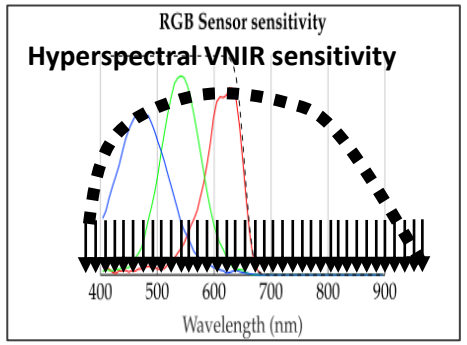
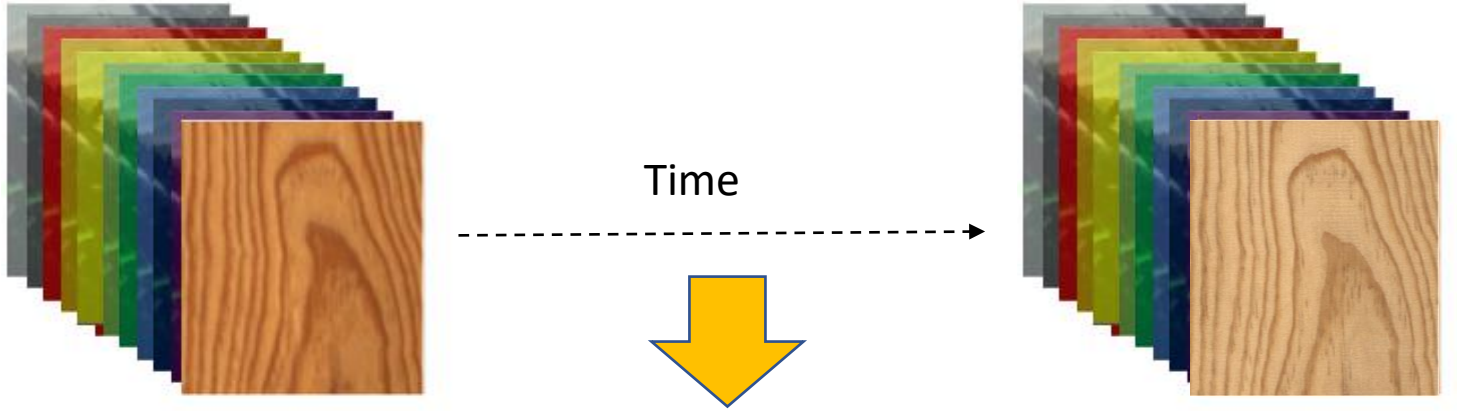




Time

300 million spectra, each with
>150 wavelength channels

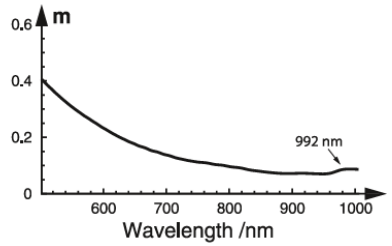


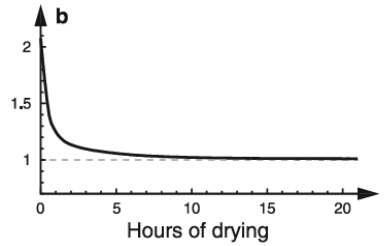


«Harmonies» «Rhythms»

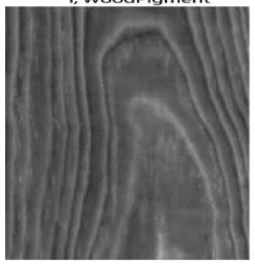
Path length b_i

«Lightness»

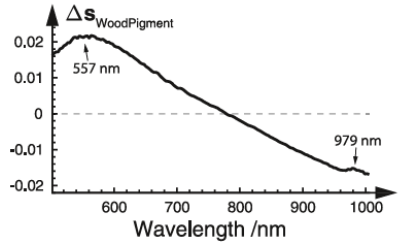


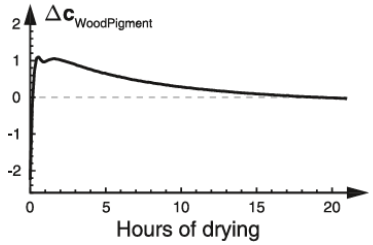


$\Delta c_{i,\ WoodPigment}$



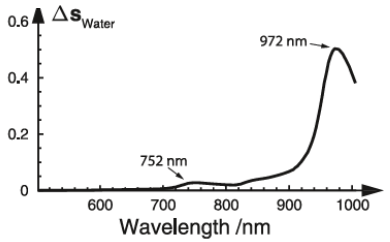
Brown color

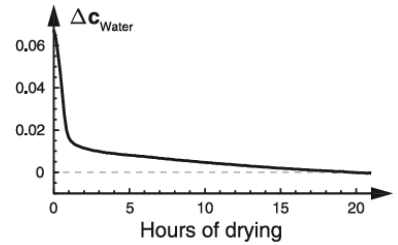




$\Delta c_{i,\ Water}$

Moisture





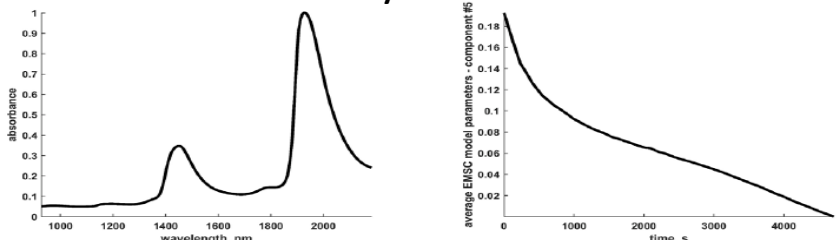
Hyperspectral time series analysis:
hyperspectral image data streams interpreted
By modeling known and unknown variations
Petter Stefansson[a,*], Joa˜o Fortuna[b,c], Hodjat Rahmati (2020)

Hyperspectral Imaging. https://doi.org/10.1016/B978-0-444-63977-6.00014-6

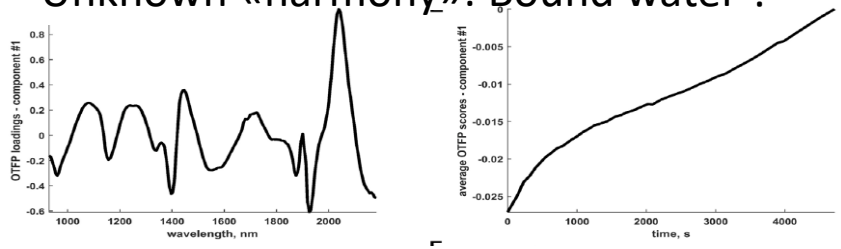
Only 8 «harmonies» explained 99.98% of variance
in 300 million spectra, each with >150 wavelength channels

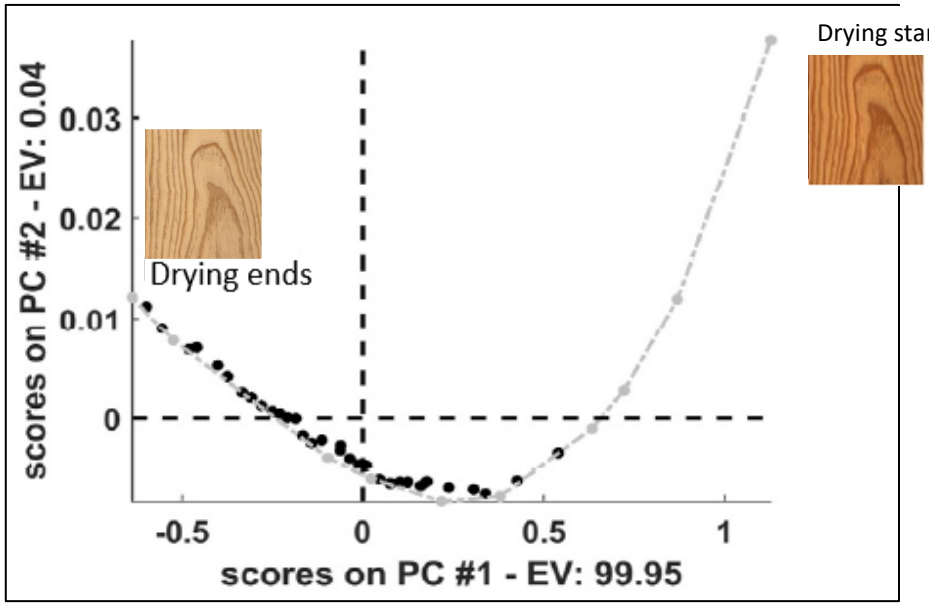
Lightness and moisture during drying: Two phases

Known «harmony»: Free water



Unknown «harmony»: Bound water ?



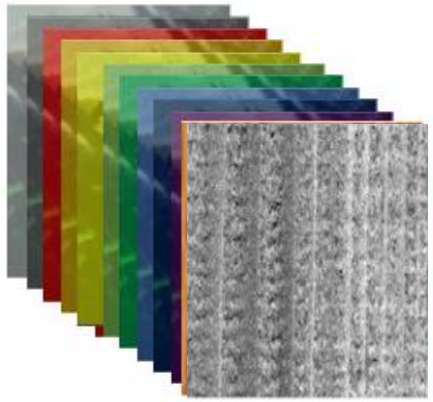


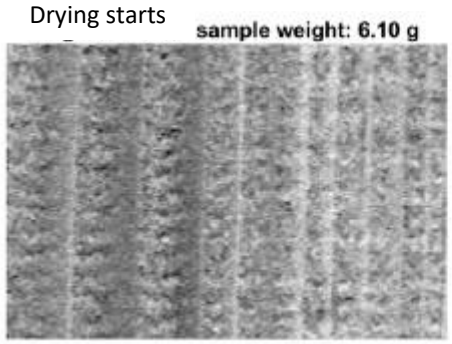
4.16 **Fast Analysis, Processing and Modeling of Hyperspectral Videos: Challenges and Possible Solutions**

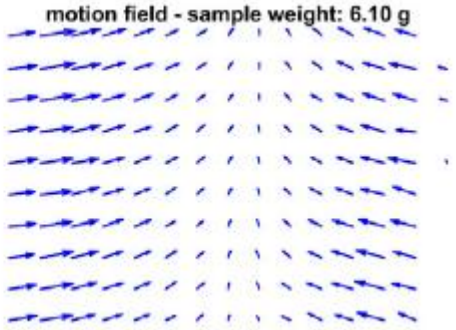
Raffaele Vitale, Univ. Lille, CNRS, LASIRE, Lille, France; and Molecular Imaging and Photonics Unit, Department of Chemistry, Katholieke Universiteit Leuven, Leuven, Belgium
Petter Stefansson, Faculty of Science and Technology, Norwegian University of Life Sciences, Ås, Norway
Federico Marini, Department of Chemistry, Università degli Studi di Roma "La Sapienza", Rome, Italy
Cyril Ruckebusch, Univ. Lille, CNRS, LASIRE, Lille, France
Ingunn Burud, Faculty of Science and Technology, Norwegian University of Life Sciences, Ås, Norway
Harald Martens, Idletechs AS, Trondheim, Norway; and Department of Engineering Cybernetics, Norwegian University of Science and Technology, Trondheim, Norway

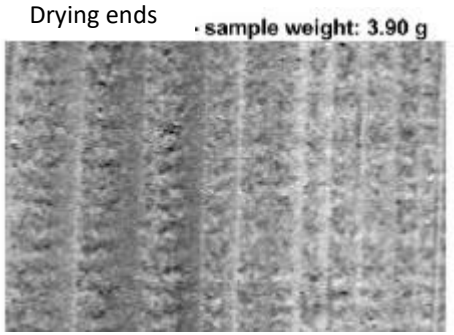
Comprehensive Chemometrics, 2nd edition, Volume 4 https://doi.org/10.1016/B978-0-12-409547-2.14605-0

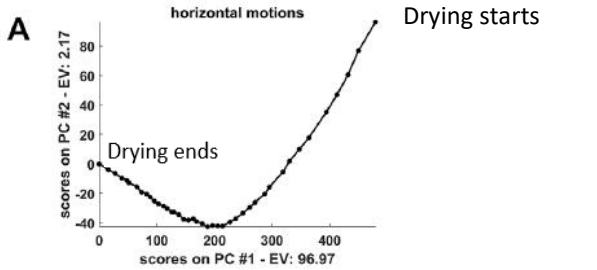
Spatial shrinkage during drying: Two phases

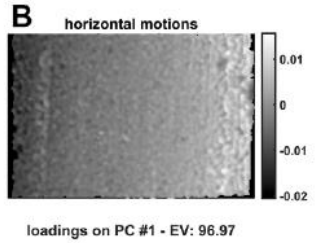


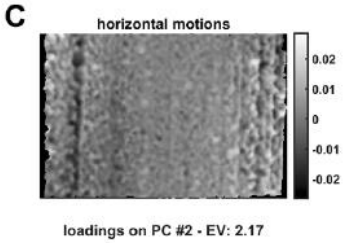










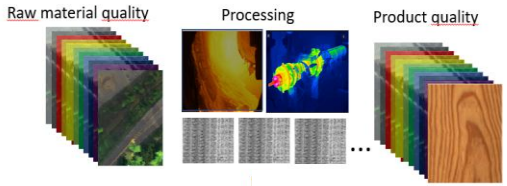


Vitale R, Ruckebusch C, Burud I and Martens H (2022)
Hyperspectral Video Analysis by Motion and Intensity Preprocessing and Subspace Autoencoding.
Front. Chem. 10:818974. doi: 10.3389/fchem.2022.818974

«Look for the underlying harmonies!»

Thank you!

idletechs

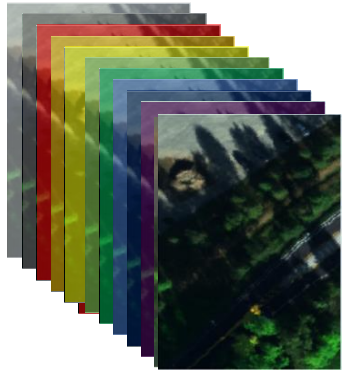


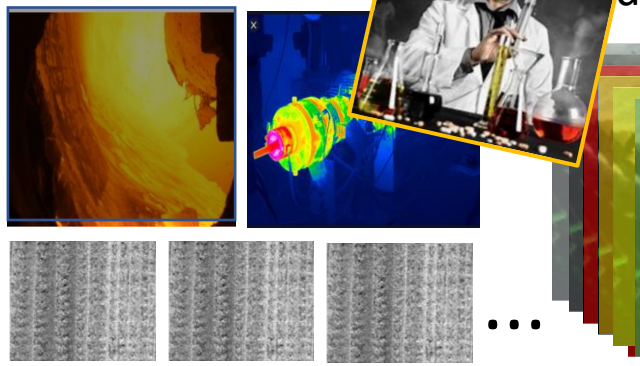
www.idletechs.com

Forest quality

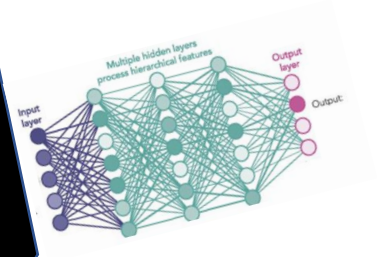
Processing

duct quality

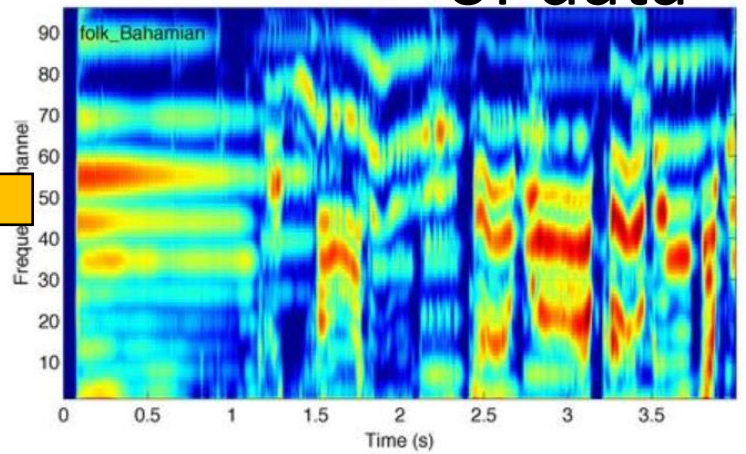




Black box AI



A cacophony of data



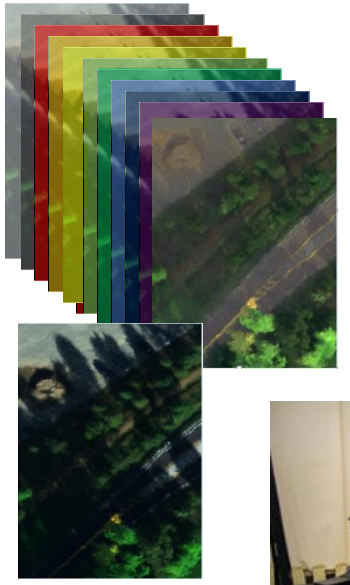
Data processing

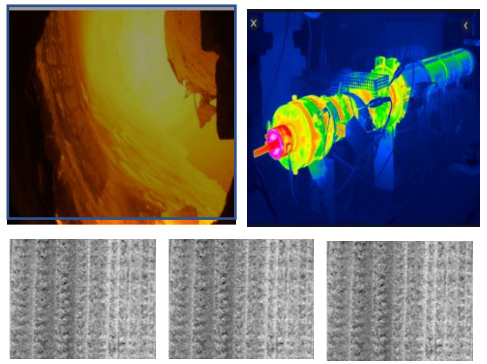
Human Perception, Interpretation and Use

Forest quality

Processing

Product quality





Aha !

Human Perception, Interpretation and Use

Data Processing:

Find the main harmonies and rhytms