LAUDATIO

for BART L.R. DE MOOR

2004 Johann Bernoulli Lecturer

by Jan C. Willems

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Biography

Halle, Vlaams Brabant, Belgium, in 1960

Studied engineering, Ph.D., at K.U. Leuven

Post-doc at Stanford University

Presently, Professor and head of the large research group SISTA, ESAT, K.U. Leuven (Systems & Control, Bio-informatics)
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Biography

- 1991-92 Chief of Staff of Wivina De Meester, Belgian minister of Science and Education
- 1992-94 Chief of Staff of Wilfried Martens, Belgian prime minister
- 1994-98 Science Advisor, Government of Flanders
Research

- Applications of SVD, numerical Linear Algebra
- Subspace Identification
- Model Predictive Control, etc.
- Quantum control and information theory
- Learning algorithms
- Bio-informatics
System identification

Observed data $\rightarrow$ System model
System identification

Observed data $\rightarrow$ System model

**Case on interest:**

**Data = a finite vector time-series record**

$$\tilde{w}(1), \tilde{w}(2), \ldots, \tilde{w}(T)$$

$$w(t) \in \mathbb{R}^w$$

**Model:**

a dynamical system that ‘explains’ this time-series
Subspace Identification

subspace algorithms (oblique projection of ‘future’ on ‘past’) pass directly from

\[ \tilde{w}(1), \ldots, \tilde{w}(t), \ldots \]

\[ \downarrow \downarrow \text{ to } \downarrow \downarrow \]

\[ \tilde{x}(1), \ldots, \tilde{x}(t), \ldots \]

a state trajectory of the system that produced the data.
Subspace Identification

\[ \sim \quad \text{Reduce the state dimension, split } w = (u, y) \]

into inputs and outputs, and solve by least squares, using the reduced \( \tilde{x} \),

\[
\begin{bmatrix}
\tilde{x}(t_1 + 1) & \cdots & \tilde{x}(t_2) \\
\tilde{y}(t_1) & \cdots & \tilde{y}(t_2 - 1)
\end{bmatrix}
= \begin{bmatrix} A & B \\ C & D \end{bmatrix}
\begin{bmatrix}
\tilde{x}(t_1) & \cdots & \tilde{x}(t_2 - 1) \\
\tilde{u}(t_1) & \cdots & \tilde{u}(t_2 - 1)
\end{bmatrix}
\]
Subspace Identification

Reduce the state dimension, split \( w = (u, y) \) into inputs and outputs, and solve by least squares, using the reduced \( \tilde{x} \),

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\begin{bmatrix}
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\tilde{u}(t_1) & \cdots & \tilde{u}(t_2 - 1)
\end{bmatrix}
\]

This leads to the identified model:

\[
\begin{align*}
x(t + 1) &= Ax(t) + Bu(t) \\
y(t) &= Cx(t) + Du(t)
\end{align*}
\]

These subspace algorithms have very nice properties...
Surf to

http://homes.esat.kuleuven.be/~demoor/

for publications, lectures, activities, ...