Beamer presentation template

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November 14, 2022

DIPARTIMENTO
DI INGEGNERIA
DELL'INFORMAZIONE

UNIVERSITÀ
DEGLI STUDI
DI PADOVA

Agenda

Introduction

System representation

System analysis

Control design

Overlay curvy arrows

$\mathcal{A}$ is a linear completely positive and trace preserving map
"Stochastic" map

ρ are density operators:
$\rho \in \mathbb{C}^{n\times n}$, $\rho = \rho^\dagger \geq 0$ and $\mathrm{tr}[\rho] = 1$
Quantum probability distributions

$$\begin{cases} \rho(t+1) = \boxed{\mathcal{A}}\left[\,\boxed{\rho(t)}\,\right] \\ \boldsymbol{p}(t) \;=\; \mathcal{C}\left[\rho(t)\right] \end{cases}$$

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$\boldsymbol{p}$ are probability vectors:
$\boldsymbol{p} \in \mathbb{R}^m$ $\boldsymbol{p}_i \geq 0$ and $\sum_i \boldsymbol{p}_i = 1$
Classical probability distribution

$\mathcal{C}$ is a linear map that gives the probabilities
of the outcome of a measurement
Oputput map

This model includes hidden markov model
but **does not include** the effects of conditioning.

Sample frame title

In this slide, some important text will be **highlighted** because it's important. Please, don't abuse it.

Remark
Sample text

Important theorem
Sample text in alert box

Examples 1
Sample text in green box. The title of the block is “Examples".

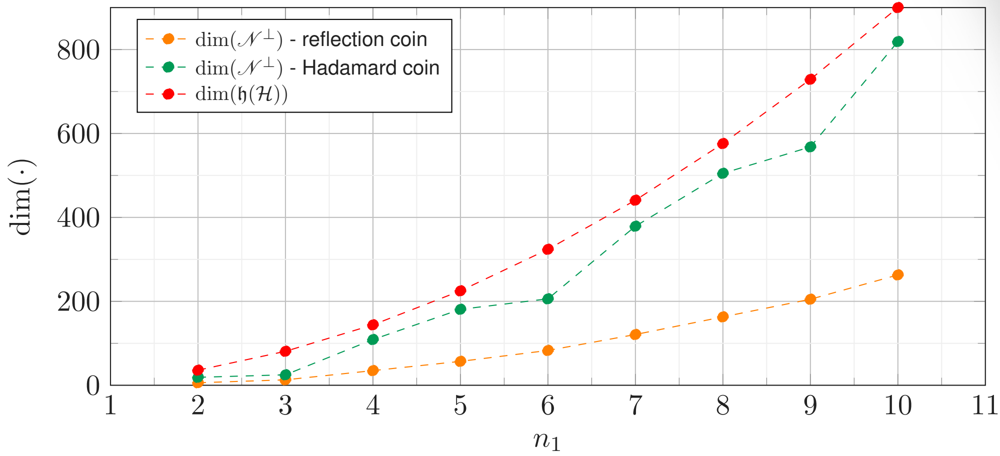
Optimal reduction

Remark

A first draft on the related “Model reduction for Hidden Markov Models” can be found on $arXiv : 2208.05968$

Let’s see some results

Analysis of the coined quantum walks



Imported code from file

$$G(s) = \frac{5s + 50}{s^2 + 101s + 100} = 5\frac{s + 10}{(s+1)(s+100)}$$

$$\begin{cases} \dot{x}(t) = Ax(t) + Bu(t) \\ y(t) = Cx(t) + Du(t) \end{cases}$$

$$A = \begin{bmatrix} 0 & 1 \\ -100 & -101 \end{bmatrix}, \qquad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix},$$

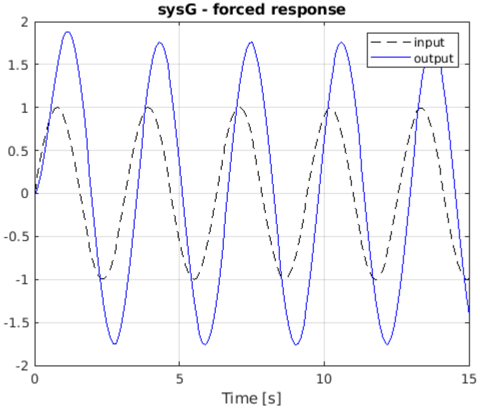
$$C = \begin{bmatrix} 50 & 5 \end{bmatrix}, \qquad D = \begin{bmatrix} 0 \end{bmatrix}$$

```
% Transfer function form
num = 5 * [1, 10];
den = [1, 101, 100];
sysG = tf(num,den)

% Zeros, Poles and Gain form
z = -10;
p = [-1, -100];
k = 5;
sysG = zpk(z,p,k)

% State space form
A = [0, 1; -100, -101];
B = [0; 1];
C = 5 * [10, 1];
D = 0;
sysG = ss(A, B, C, D)
```

Inline code (Clearly needs some work)



Display forced response

```
t = 0:0.1:15;
u = sin(2*t);
x0 = 0;
y = lsim(sysG, u, t,
    x0);

figure;
plot(t, u, 'k--');
hold on;
plot(t, y, 'b');
legend('input',
    'output');
grid on;
```

Columns

Encapsulated form:
The CST stores and uses the model-related data via LTI objects (objects in the sense of object-oriented programming).

Non-encapsulated form:
poles and zeros, state/input/output matrices etc. etc.

From the encapsulated form it is possible to access the non-encapsulated data via dot-notation

Conclusions and outlook

Classical control tools can be used to study quantum walks and find the minimal linear model capable of reproducing the output probability distribution.
Grover's algorithm uses surprisingly few resources.

Future directions:

- Robustness to initialization errors.
- More general output functions.
- **Completely positive and trace preserving constraint.**

Thank you for your attention!

My website

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