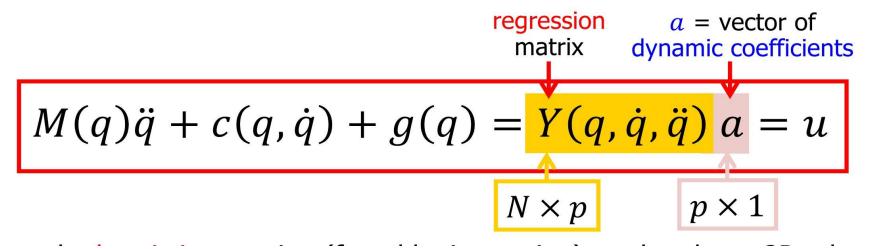
The Robot Linear Dynamic Regressor

The Robot Linear Regressor

It is always possible to rewrite the dynamics of a robot in the form



- These parameters are instrumental to control the robot effectively and usually they are not provided by the robot manufacturers
- The relationship is linear!

How to Compute the Dynamic Parameters (1)

 At each time step of our simulation we can compute one regressor matrix defined as

$$Y_t(q(t), \dot{q}(t), \ddot{q}(t))a = u(t)$$

• Where Y_t is the regressor matrix at time t, **a** represents the system parameters, and u(t) is the control input at time t

How to Compute the Dynamic Parameters (2)

• Given the regressor matrices Y_t and control inputs u(t) at each time step t from t = 1 to t = T, we can stack these to form:

$$\hat{Y}a = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_T \end{bmatrix} a = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_T \end{bmatrix} = \hat{u}$$

 To solve for a, we compute the pseudoinverse of the stacked regressor matrix

$$a = \hat{Y}^+ \hat{u}$$

Configuration File

 For this Lab session activate the noise and start with a small noise like in the picture.

Laboratory Objectives (1)

Parameters Estimation

Write the code to collect the data for computing the dynamic parameters

```
# Compute regressor and store it
cur_regressor = dyn_model.ComputeDynamicRegressor(q_mes, qd_mes, qdd_mes)
```

Model Validation

- After estimating the parameters, validate the model by comparing the simulated output of the manipulator with the model learned of the estimated parameters
- Compute the adjusted R-squared
- Compute the **F-Statistics**
- Compute the confidence interval for the parameters and for the prediction

Laboratory Objectives (2)

Model Validation with increasing noise

- Repeat the first task by increasing the noise on joint_pos, joint_vel and joint_acc by changing the covariance value:
- 0.01
- 0.1
- 1
- Recompute for each of this value the previous statistics

You can find a script from which you can start working your code in this repo week_12

https://github.com/VModugno/lab_sessions_COMP0245_PUBLIC