



MATLAB OPC Toolbox

Hans-Petter Halvorsen, M.Sc.

Software

You need the following Software:

- OPC Server (e.g., MatrikonOPC Simulation Server, Free Download)
- MATLAB
- MATLAB OPC Toolbox

www.mathworks.com/products/opc



MATLAB

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What is MATLAB?

- MATLAB is a tool for technical computing, computation and visualization in an integrated environment.
- MATLAB is an abbreviation for MATrix LABoratory
- It is well suited for Matrix manipulation and problem solving related to Linear Algebra, Modelling, Simulation and Control Applications
- Popular in Universities, Teaching and Research

The MATLAB Environment (IDE)

The image shows the MATLAB R2014a IDE interface. The main window is titled "MATLAB R2014a" and contains several panes:

- Current Folder:** Located on the left, it shows a file explorer view of the current directory, listing files like `bode_ex.m`, `cylindar_surface.m`, `level_tank.m`, and `test1.m`.
- Script Editor:** The central pane shows the MATLAB script `level_tank.m` with the following code:

```
1 clc, clear
2 Kp = 16.5;
3 A_tank = 78.5;
4
5 A = [0, -1/A_tank; 0, 0];
6 B = [Kp/A_tank; 0];
7 C = [1, 0];
8 D = [0];
9
10 model = ss(A, B, C, D)
11
12 step(model)
13
14 H = tf(model)
15
16
17
18 step(H)
```
- Plot Window:** A window titled "Figure 1" displays a "Step Response" plot. The x-axis is labeled "Time(seconds)" and ranges from 0 to 40. The y-axis is labeled "Amplitude" and ranges from 0 to 9. A blue line starts at the origin (0,0) and increases linearly to approximately (40, 8.5).
- Workspace:** Located on the right, it shows a list of variables in the workspace:

Name	Value	Size
A	[0, -0.0127; 0, 0]	-0
A_tank	78.5000	78
B	[0.2102; 0]	0
C	[1, 0]	0
D	0	0
H	1×1 tf	16
Kp	16.5000	
model	1×1 ss	
- Command Window:** Located at the bottom, it shows the output of the script:

```
New to MATLAB? Watch this Video.
ui
y1
0
Continuous-time state-space model.

H =
    0.2102
    -----
         s
Continuous-time transfer function.

fx >>
```

MATLAB Syntax - Example

Defining Vectors



```
clear
clc
close all
```

```
x=[0, 1, 2, 3, 4 ,5];
y=[15, 10, 9, 6, 2 ,0];
```

For Loop



```
for n=1:6 % n = model order
```

```
    p = polyfit(x,y,n)
```

```
    ymodel = polyval(p,x);
```

Built-in Functions



```
    subplot(3,2,n)
```

```
    plot(x,y,'o',x,ymodel)
```

```
    title(sprintf('Model order %d', n));
```

50+ Toolboxes

```
end
```

Installation

MATLAB for
Student Use



http://www.mathworks.com/academia/student_version

2 different options:

- **MATLAB and Simulink Student Suite (NOK699)**

Included: MATLAB + Simulink + Statistics Toolbox + Optimization Toolbox + Symbolic Math Toolbox + Control System Toolbox + Signal Processing Toolbox + Image Processing Toolbox, ...

- **MATLAB Student (NOK350+)**

Includes MATLAB only. Add-on products must be purchased separately (NOK70/Toolbox if you buy them at the same time, else NOK200/Toolbox).
Select between 55 different Toolboxes



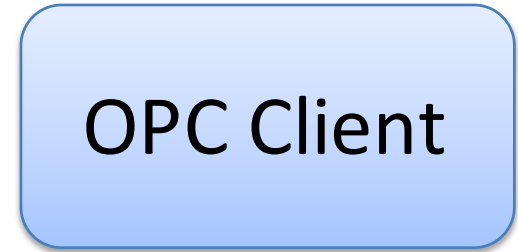
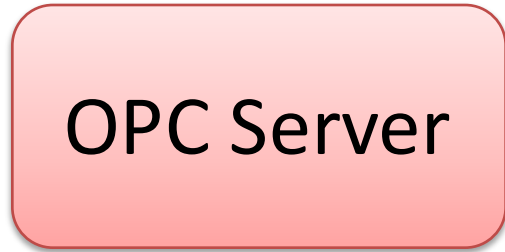
OPC

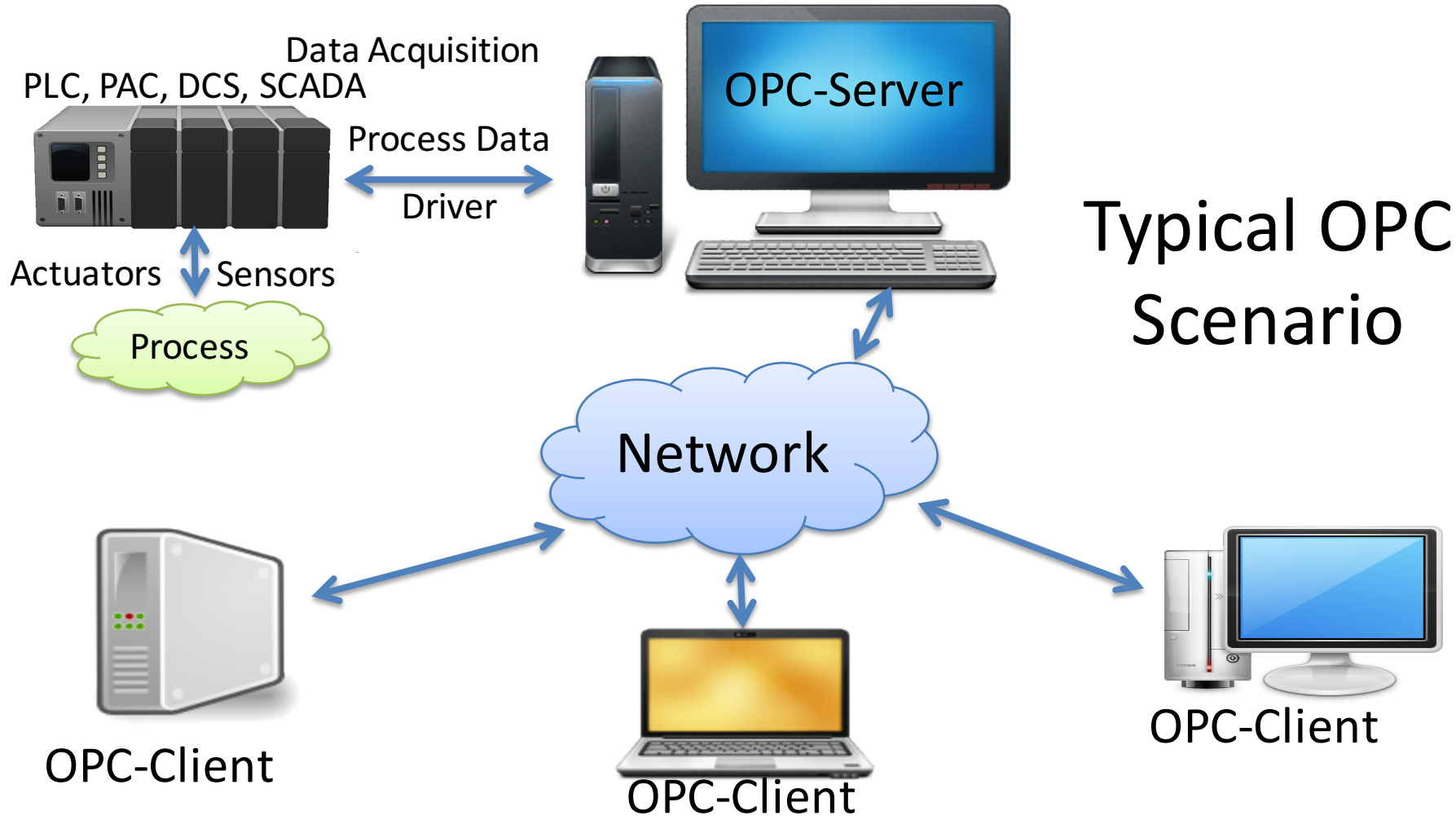
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What is OPC?

- **A standard that defines the communication of data between devices from different manufactures**
- Requires an **OPC server** that communicates with the **OPC clients**
- OPC allows “plug-and-play”, gives benefits as reduces installation time and the opportunity to choose products from different manufactures
- Different standards: “Real-time” data (**OPC DA**), Historical data (**OPC HDA**), Alarm & Event data (**OPC AE**), etc.

OPC





Typical OPC Scenario

OPC Specifications

“Classic” OPC

“Next Generation” OPC

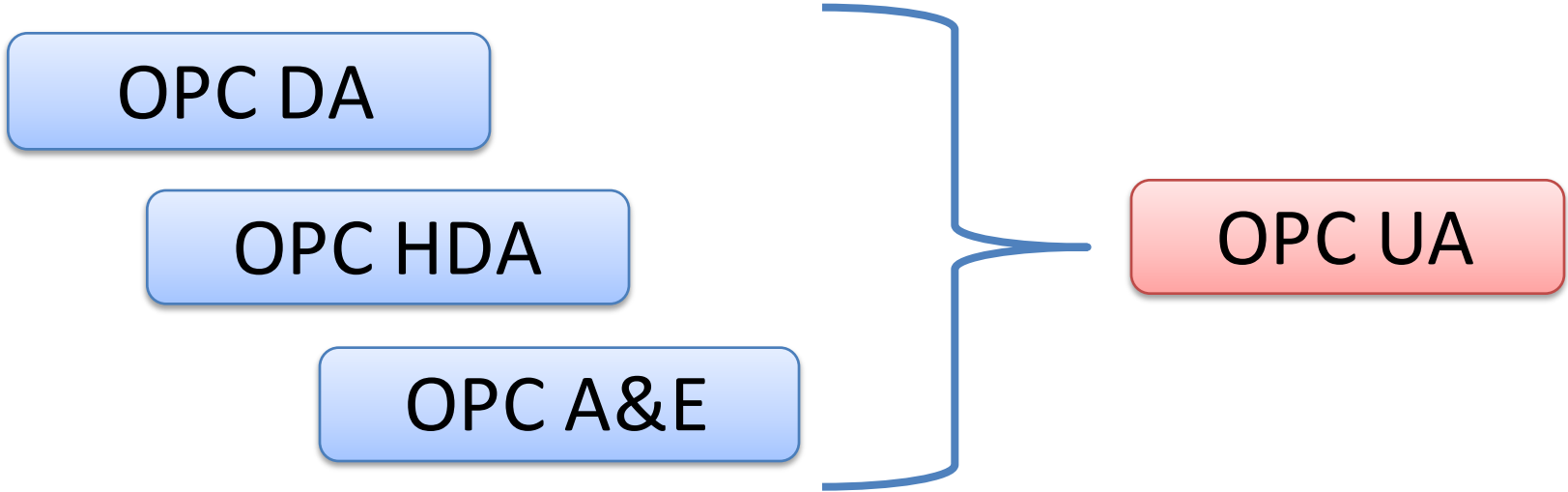
OPC DA

OPC HDA

OPC A&E

OPC UA

... (Many others)



OPC Specifications



- **OPC DA** (Data Access)

The most common OPC specification is OPC DA, which is used to read and write “real-time” data. When vendors refer to OPC generically, they typically mean OPC DA.

- **OPC HDA** (Historical Data Access)

- **OPC A & E** (Alarms & Events)

- ... (many others)

These OPC specification are based on the OLE, COM, and DCOM technologies developed by Microsoft for the Microsoft Windows operating system family. This makes it complicated to make it work in a modern Network! Typically you need a Tunneller Software in order to share the OPC data in a network (between OPC Servers and Clients)

- **OPC UA** (Unified Architecture)

OPC UA eliminating the need to use a Microsoft Windows based platform of earlier OPC versions. OPC UA combines the functionality of the existing OPC interfaces with new technologies such as XML and Web Services (HTTP, SOAP)



MATLAB OPC Toolbox



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MATLAB OPC Toolbox

- OPC Toolbox provides access to live and historical OPC data directly from MATLAB and Simulink
- You can read, write, and log OPC data from devices, such as distributed control systems (DCS), supervisory control and data acquisition systems (SCADA), and programmable logic controllers (PLC)

MATLAB OPC Toolbox

The MATLAB OPC Toolbox supports the following OPC protocols:

- OPC DA (Data Access)  This Video
- OPC HDA (Historical Data Access)
- OPC UA (Unified Architecture)  A Later Video

Run OPCREGISTER (64-bit users only)

If you are running 64-bit MATLAB, you should re-register the OPC Foundation Core Components that ship with MATLAB. This enables the 64-bit MATLAB application to browse for 32-bit servers on your machine.



```
opcregister('-silent')
```

Run this command in the
MATLAB Command window

Verify the Existence of the OPC Simulation Server

Browse for OPC servers on your local machine to verify that the OPC Simulation Server has been successfully installed.

```
sInfo = opcserverinfo('localhost')
```

```
sInfo =  
      Host: 'localhost'  
      ServerID: {'Matrikon.OPC.Simulation.1' 'OSI.DA.1' 'OSI.HDA.1'}  
      ServerDescription: {1x3 cell}  
      OPCSpecification: {'DA2' 'DA2' 'DA2'}  
      ObjectConstructor: {1x3 cell}
```

The list of ServerIDs should include `Matrikon.OPC.Simulation.1`

Acquire Data from an OPC Data Access Server (with Examples): <http://se.mathworks.com/help/opc/examples/acquire-data-from-an-opc-data-access-server.html?prodcode=OT&language=en>

MATLAB OPC Toolbox

For more information about the MATLAB OPC Toolbox:

www.mathworks.com/products/opc

Acquire Data from an OPC Data Access Server (with Examples):

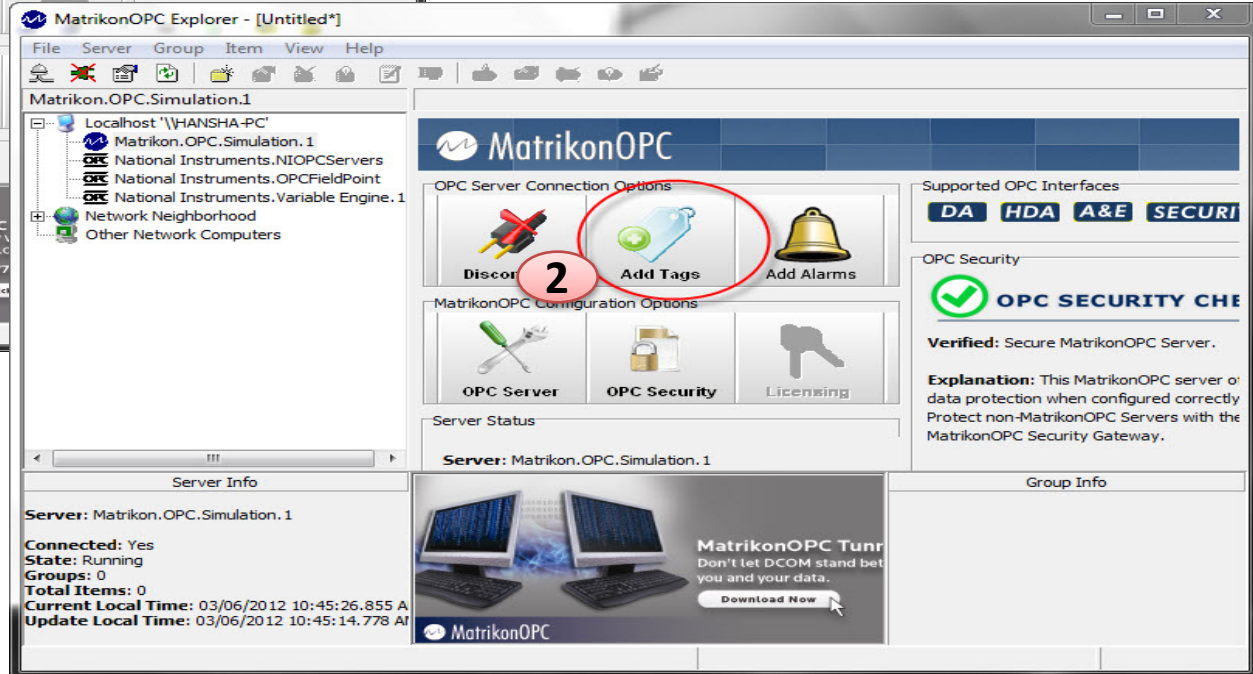
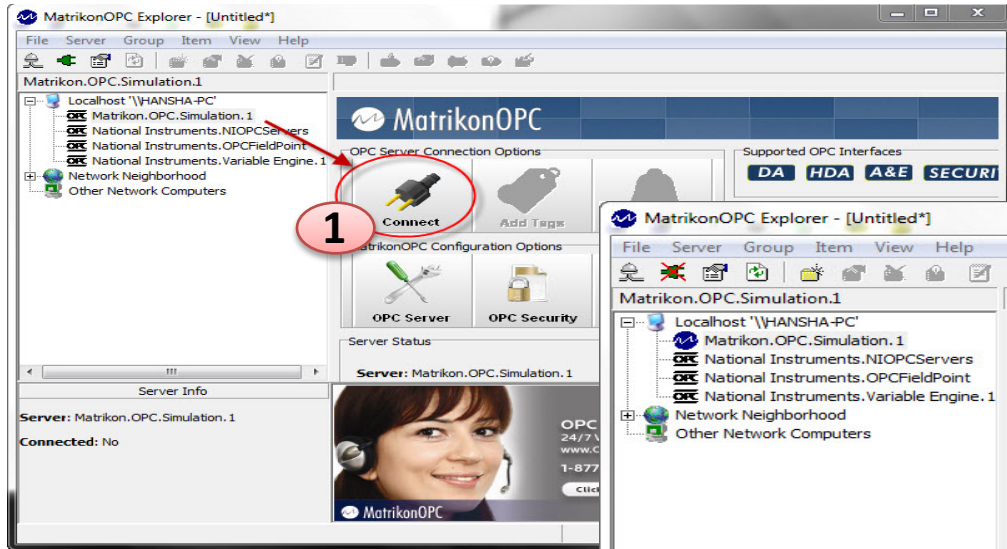
<http://se.mathworks.com/help/opc/examples/acquire-data-from-an-opc-data-access-server.html?prodcode=OT&language=en>



Matrikon OPC Simulation Server

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Matrikon OPC Explorer – Connect to Server



Matrikon OPC Explorer - Add Tags



4

3

1

2

5

Finished

Double-click

Item ID: Bucket Brigade.Real4

Data Type: Empty/Default

Access Path:

Filter: Data Type Filter: Empty/Default

Write Access Read Access Branches Items

Available Items in Server 'Matrikon.OPC.Simulation.1':

- Simulation Items
- Bucket Brigade
- Random
- Read Error
- Saw-toothed Waves
- Square Waves
- Triangle Waves
- Write Error
- Write Only
- Configured Aliases

Available Tags

- Int1
- Int2
- Int4
- Money
- Real4
- Real8

Tags to be added:

- Bucket Brigade.Real4

Item ID	Access Path	Value	Quality
Bucket Brigade.Real4		22	Good, non-specific

5

Finished

Server Info

Server: Matrikon.OPC.Simulation.1

Connected: Yes

State: Running

Groups: 1

Total Items: 1

Update Local Time: 03/06/2012 10:59:22.417 A

Update Local Time: 03/06/2012 10:59:16.300 A

Group Info

Group: Group0

Connected (Async I/O): Yes (2.0)

Active: Yes

Items: 1

Current Update Rate: 1000 ms

Percent Deadband: 0.00%

Data Change Rate: 0.01 Items/Sec

MatrikonOPC Explorer (OPC Client)

The screenshot displays the MatrikonOPC Explorer application window. The title bar reads "MatrikonOPC Explorer - [Untitled*]". The menu bar includes "File", "Server", "Group", "Item", "View", and "Help".

The left pane shows a tree view under "Group0" with the following structure:

- Localhost '\\HANSHA-PC'
- Matrikon.OPC.Simulation.1
 - Group0
 - National Instruments.NIOPCServers
 - National Instruments.OPCFieldPoint
 - National Instruments.Variable Engine.1
- Network Neighborhood
- Other Network Computers

The main pane displays the "Contents of 'Group0'" table:

Item ID	Access Path	Value	Quality
Bucket Brigade.Real4		22	Good, non-specific

The bottom-left pane shows "Server Info" for "Matrikon.OPC.Simulation.1":

- Server: Matrikon.OPC.Simulation.1
- Connected: Yes
- State: Running
- Groups: 1
- Total Items: 1
- Current Local Time: 03/06/2012 10:59:22.417 A
- Update Local Time: 03/06/2012 10:59:16.300 A

The bottom-right pane shows a table of OPC tags with a context menu open over the "Square Waves.Int4" row:

Item ID	Access Path	Value	Quality
Random.Boolean		False	Good, non-specific
Square Waves.Int4		-8	Good, non-specific

The context menu options are:

- Write Values
- Deactivate
- Delete (Del)
- Export Items
- Properties (Alt+Enter)

A small inset image in the bottom center shows a laptop displaying the MatrikonOPC Explorer interface.

The MatrikonOPC Explorer is useful for testing. You can use it for writing and reading OPC Tags

Examples



MATLAB OPC Toolbox

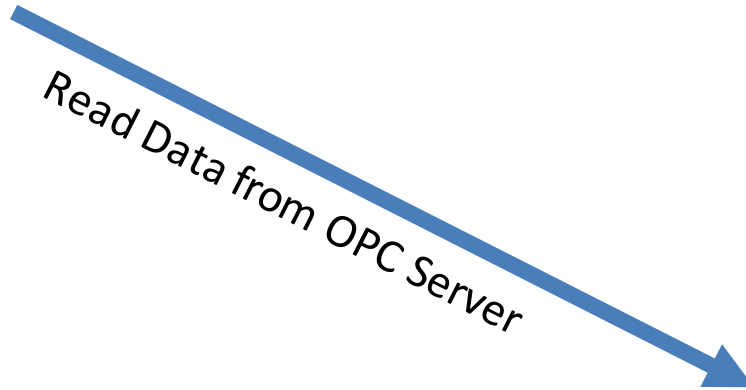
Read Data from OPC DA Server

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OPC Server

With MATLAB OPC Toolbox you can create OPC Clients that Write or Read to an OPC Server



OPC Client



MATLAB is a Tool typically used for Data Analysis, so you typically Read Data from the OPC Server.

(But it is possible to connect DAQ devices and Read Measurement Data into MATLAB and then Write those Data Values to an OPC Server)



```
clear, clc
% Connect to OPC Server
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');
connect(da);

% Create Group
grp = addgroup(da, 'DemoGroup');

%Add Tags
itmIDs = {'Random.Real8'};
itm = additem(grp, itmIDs);

% Retrieve Data
data = read(grp);
opcdata = data.Value

%Clean Up
disconnect(da)
delete(da)
```

MATLAB OPC Read Example 1

This simple Example reads only
one value from the Server

DEMO



MATLAB OPC

Read

Example 2

This simple Example reads values from the Server.

This Examples reads N values using a For Loop

```
clear, clc
```

```
% Connect to OPC Server  
da = opcda('localhost',  
'Matrikon.OPC.Simulation.1');  
connect(da);
```

```
% Create Group  
grp = addgroup(da, 'DemoGroup');
```

```
%Add Tags  
itmIDs = {'Random.Real8'};  
itm = additem(grp, itmIDs);
```

```
% Retrieve Data  
N=10;  
for i=1:N  
    data = read(grp);  
    opcddata(i) = data.Value;  
    pause(2)  
end
```

```
%Clean Up  
disconnect(da)  
delete(da)
```

```
plot(opcddata)
```

DEMO



MATLAB OPC

Read

Example 3

This simple Example uses some of the more advanced features in the MATLAB OPC Toolbox.
No For/While Loop needed!

```
clear, clc
% Connect to OPC Server
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');
connect(da);
% Create Group
grp = addgroup(da, 'DemoGroup');
%Add Tags
itmIDs = {'Random.Real8'};
itm = additem(grp, itmIDs)
% Set Properties
logDuration = 60;logRate = 0.2;
numRecords = ceil(logDuration./logRate)
grp.UpdateRate = logRate;
grp.RecordsToAcquire = numRecords;
% Acquire Data
start(grp), wait(grp)
% Retrieve Data
[logIDs, logVal, logQual, logTime, logEvtTime] =
getdata(grp, 'double');
% Plot Data
plot(logTime, logVal);
axis tight
datetick('x', 'keeplimits')
legend(logIDs)
%Clean Up
disconnect(da)
delete(da)
```

DEMO

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