



EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
“Energetic Macroscopic Representation”

« State of the EMR Editor »

Prof. Ruben Gonzalez-Rubio, Prof. João P. TROVÃO.

¹ e-TESC Lab, Université de Sherbrooke, Québec, Canada

Video works on Mac



Context

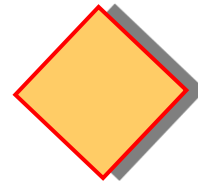


EMR Editor



State and Conclusion

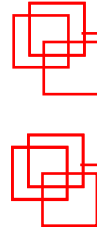
Next year the Editor will be available



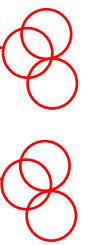
Appendix: Graphical Rules of EMR



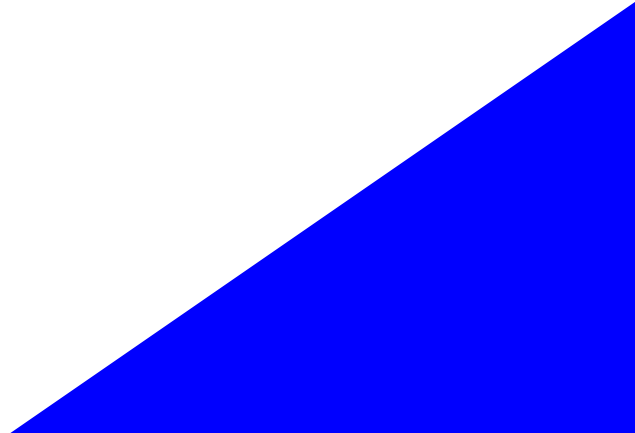
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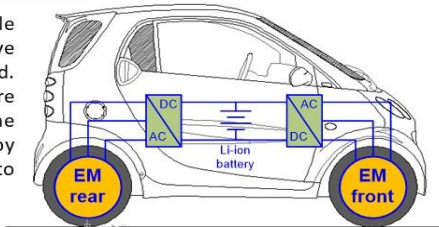
« Context »





IEEE VTS Motor Vehicles Challenge 2021 ENERGY MANAGEMENT OF A DUAL-MOTOR ALL-WHEEL DRIVE ELECTRIC VEHICLE

In this fifth IEEE VTS Motor Vehicle Challenge, a dual-motor all-wheel drive (AWD) electric vehicle (EV) is studied. Two different electrical motors (EMs) are installed in the front and rear axes of the EV, respectively. The EMs are driven by the two inverters connected in parallel to a Li-ion battery.



THE CHALLENGE

The challenge is to develop an Energy Management Strategy (EMS) to reduce the motor drives losses in order to extend the range of the vehicle. The MATLAB/Simulink model of the studied AWD EV will be provided. Participated teams will develop their own EMSs to be compared on this common model. There will be two samples of speed profiles provided to the teams to test their EMSs. The submitted EMSs will be evaluated by using a third unknown profile. The participants will be invited to attend the IEEE VPPC 2021.

PRIZES

First prize: US\$3500 grant to attend the IEEE VPPC 2021

Second prize: US\$1500 grant to attend the IEEE VPPC 2021

This competition is open to everyone (students, academics, and industry). However, *only VTS members* are eligible to receive the grant, so JOIN US NOW!

COMMITTEE

Challenge Committee Chairs

João Pedro F. Trovão, Université de Sherbrooke, Canada

Samir Jemeï, Université de Franche-Comté, France

Loïc Boulon, Université du Québec à Trois-Rivières, Canada

VPP Technical Committee Chair

Alain Bouscayrol, Université de Lille, France

Challenge Technical Committee

Bão-Huy Nguyễn, Univ. de Sherbrooke, Canada

IMPORTANT DATE

Registration: December 20, 2020

Submission: February 22, 2021

Results: March 15, 2021

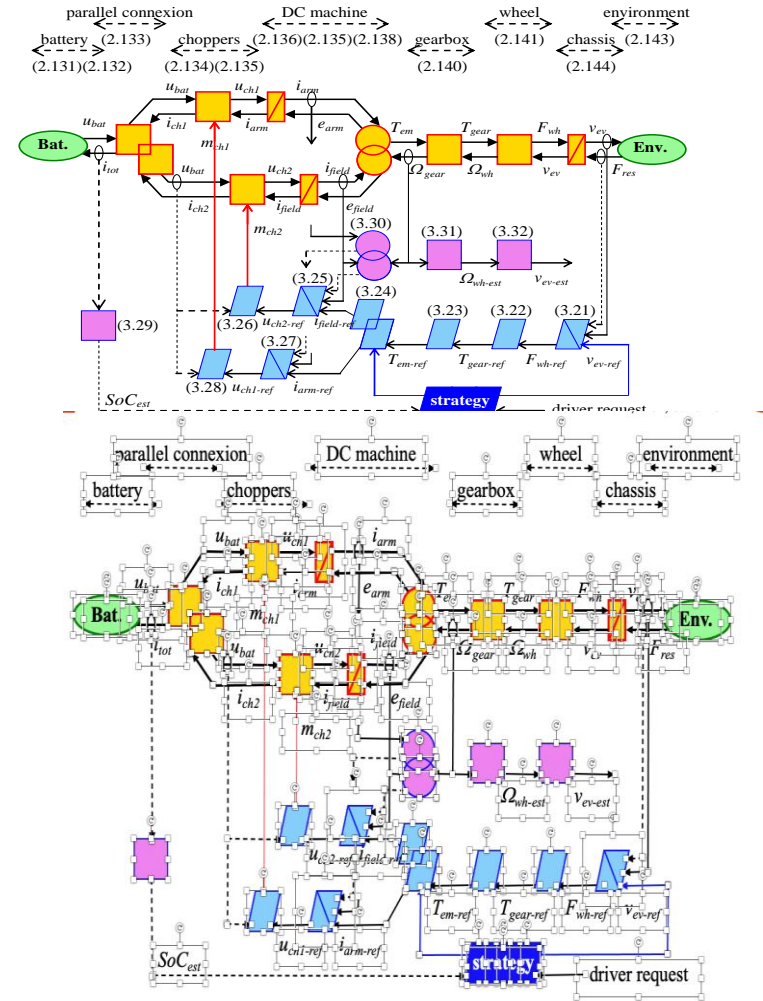


Source: e-TESC Lab and Association des Transports Électriques de l'Université de Sherbrooke



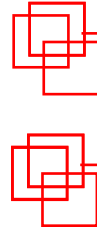
<http://www.motorvehicleschallenge.org/>

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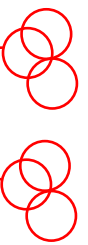




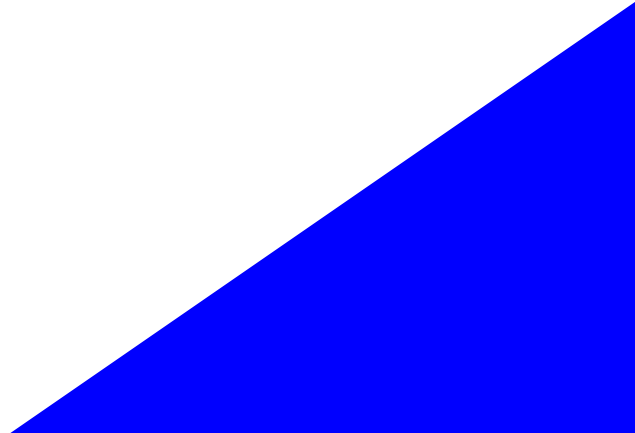
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« EMR Editor »



Bad example (1990):

A very simple editor : Text interface:

- Q: What do you want to add?
- A: Energy Source
- Q Where?
- A 100, 100
- Q: What do you want to add?
- A: Energy Accumulation
- I don't know this element, what do you want to add?
- ...

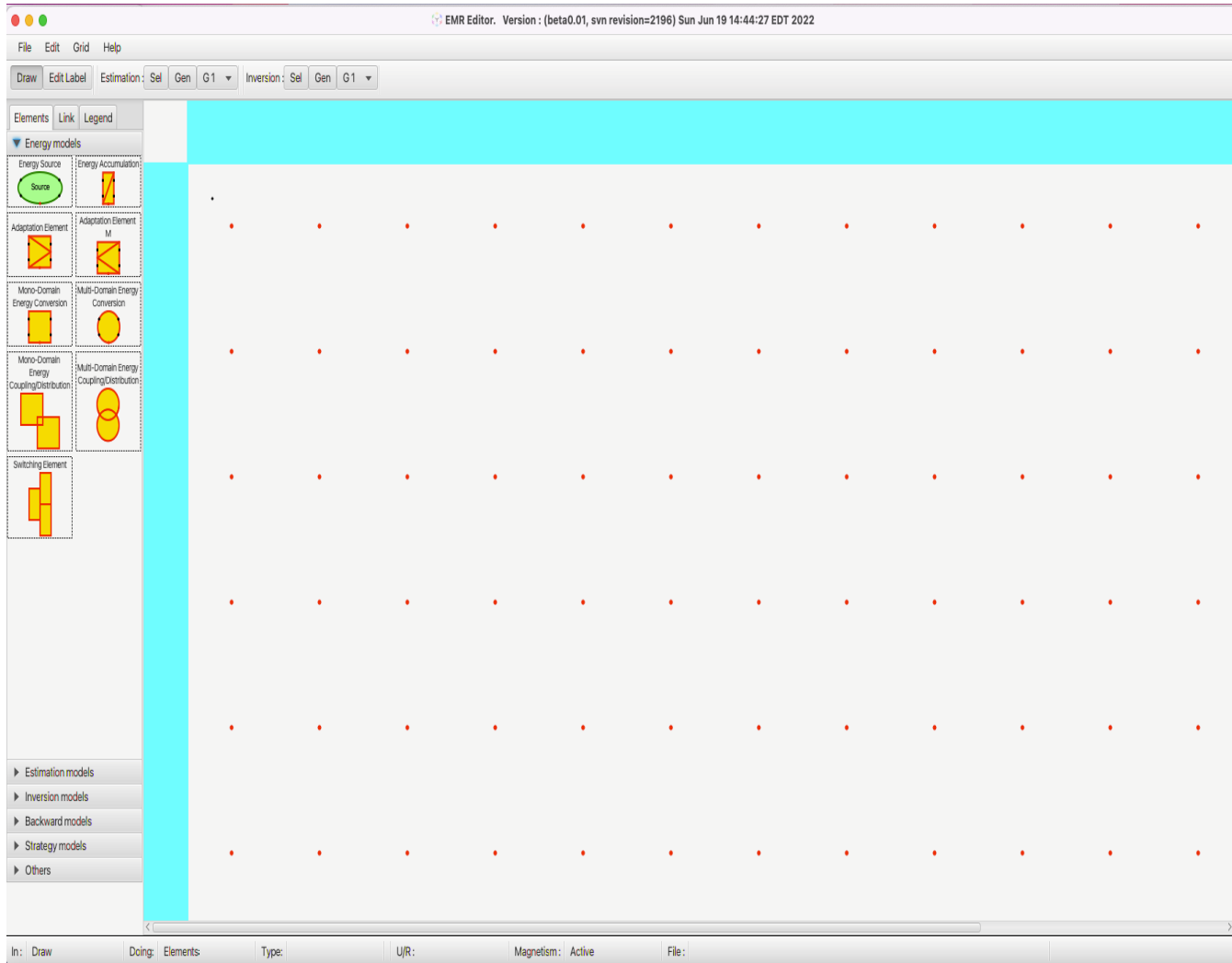
Development using a modern Graphical User Interface.

« State of the EMR Editor »

- Development -

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- GUI
- Menus,
- Elements,
- ToolBar,
- Status Bar,
- Alignment :
- Magnetism,
- No magnetism
- Save text
- Save semantics
- ...

Difficulties on developing an application with a GUI:

React to different situations:

- Exit (remember to save)
- Adding elements (power, estimation, inversion)
- Adding connexions of different types
- Avoid user errors: superposing elements
- ...

Solutions

- Atomic operations
- Various nested FSA final state automaton
- ...

The more “operations” are implemented, application will be more complex, the more test and verification are needed.

« State of the EMR Editor »

- Development -

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The screenshot displays the EMR Editor software interface. At the top, the title bar reads "EMR Editor. Version : (beta0.01, svn revision=2196) Mon Jun 20 07:52:46 EDT 2022". Below the title bar is a menu bar with "File", "Edit", "Grid", and "Help". A toolbar contains buttons for "Draw", "Edit Label", and dropdown menus for "Estimation : Sel Gen G1" and "Inversion : Sel Gen G1".

The main workspace is a large grid of elements. A vertical cyan bar is on the left side of the grid. The grid contains several rows of elements, each represented by a small red dot. The elements are organized into categories in the left sidebar:

- Energy models
 - Energy Source (Source)
 - Energy Accumulation
 - Adaptation Element
 - Adaptation Element M
 - Mono-Domain Energy Conversion
 - Multi-Domain Energy Conversion
 - Mono-Domain Energy Coupling/Distribution
 - Multi-Domain Energy Coupling/Distribution
 - Switching Element
- Estimation models
- Inversion models
- Backward models
- Strategy models
- Others

At the bottom of the interface, there is a status bar with the following information: "In: Draw", "Doing: Elements", "Type:", "U/R:", "Magnetism: Active", and "File:".

« State of the EMR Editor »

- Development -

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The screenshot displays the EMR Editor software interface. At the top, the title bar reads "EMR Editor. Version : (beta0.01, svn revision=2196) Mon Jun 20 07:57:30 EDT 2022". Below the title bar is a menu bar with "File", "Edit", "Grid", and "Help". A toolbar contains buttons for "Draw", "Edit Label", and dropdown menus for "Estimation : Sel Gen G1" and "Inversion : Sel Gen G1".

The main workspace is a large grid of elements. A vertical cyan bar is on the left side of the grid. The grid contains several rows of elements, each represented by a small icon and a red dot. The icons include a green circle labeled "Source", a yellow square with a diagonal line, a yellow square with a diagonal line and a small 'M', a yellow square, a yellow circle, a yellow square with a diagonal line and a small 'M', a yellow square with a diagonal line and a small 'M', and a yellow square with a diagonal line and a small 'M'.

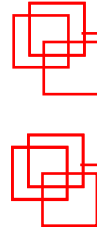
On the left side of the grid, there is a sidebar with the following sections:

- Elements Link Legend
- Energy models
 - Energy Source (Source)
 - Energy Accumulation
 - Adaptation Element
 - Adaptation Element M
 - Mono-Domain Energy Conversion
 - Multi-Domain Energy Conversion
 - Mono-Domain Energy Coupling/Distribution
 - Multi-Domain Energy Coupling/Distribution
 - Switching Element
- Estimation models
- Inversion models
- Backward models
- Strategy models
- Others

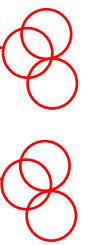
At the bottom of the interface, there is a status bar with the following information: "In: Draw", "Dcing: Elements", "Type:", "U/R:", "Magnetism: Active", "File:".



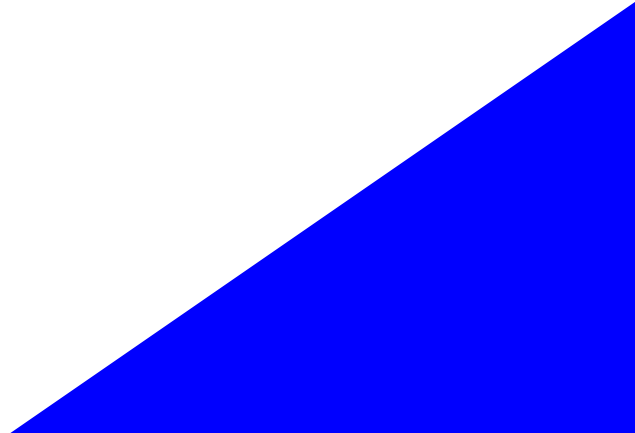
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« State and Conclusions »



The EMR Editor
It is now on
freezing.
All functionalities
are on review (test
and verification).

Welcome to the EMR Editor HomePage

You must follow the instructions to install and use the EMR Editor

A reference to EMR must be placed here

The EMR Editor is not yet finished. We will publish new versions as soon as possible.

Consult the page frequently to update the new versions.

The editor is developed in Java, so it is necessary to download files allowing application execution.

All instructions and versions are on the page corresponding to the system that you use.

If you are on Windows go to next link : [Windows](#)

If you are on Mac OS go to next link : [Mac OS](#)

For any problem, please contact us at : ruben.gonzalez-rubio@usherbrooke.ca

Page Web:

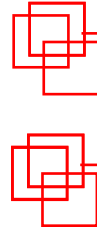
<https://www.gegi.usherbrooke.ca/e-TEESC/emreditor/>

All elements are well defined, connexions work, GUI operations work fine, save works, png works. Some test and verification are still needed.

- Conclusion:
 - The external functionalities:
 - Easy to use,
 - Produce EMR diagrams following the graphical rules of EMR.
 - The code:
 - Object-oriented well organized, very few redundancies, very few dependencies.



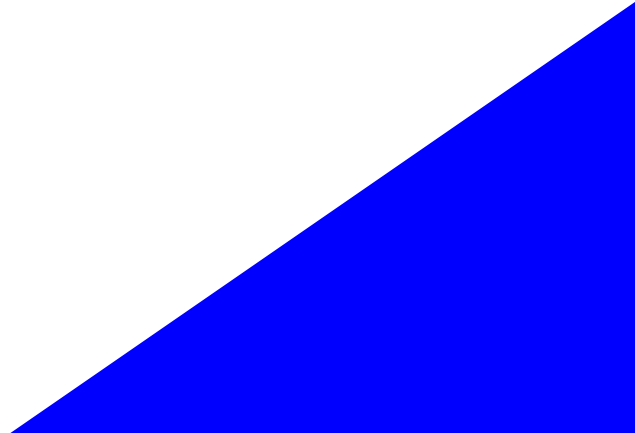
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« **BIOGRAPHIES AND REFERENCES** »





Prof. Ruben GONZALEZ-RUBIO

Université de Sherbrooke, eXit Lab., Qc, Canada

DèsS in Mathematics at Université Pierre et Marie Curie (1987).

Research topics: Software engineering, Optimization, Artificial Intelligence.



Prof. João P. TROVÃO

Université de Sherbrooke, Sherbrooke, QC, Canada

PhD in Electrical Engineering at University of Coimbra, Portugal (2012)

Research topics: EVs, renewable energy, energy management, power quality, and rotating electrical machines



- A. Bouscayrol et al., "Teaching drive control using Energetic Macroscopic Representation — Summer schools," Proceedings of the 2011 14th European Conference on Power Electronics and Applications, Birmingham, 2011, pp. 1-6.
- A. Bouscayrol. "Graphical rules of EMR", *Document Web EMR-graphical-rules-2014-v2*
- A. Bouscayrol, J. P. Hautier, B. Lemaire-Semail, "Graphic formalisms for the Control of Multi-Physical Energetic Systems", Systemic Design Methodologies for Electrical Energy, tome 1, Analysis, Synthesis and Management, Chapter 3, ISTE Willey editions, October 2012, ISBN: 9781848213883
- W. Lhomme, P. Delarue, A. Bouscayrol, A., Barrade P., "La REM, formalisme multiphysique de commande de systèmes énergétiques", Article techniques de l'ingénieurs, D 3 0066, 2015.

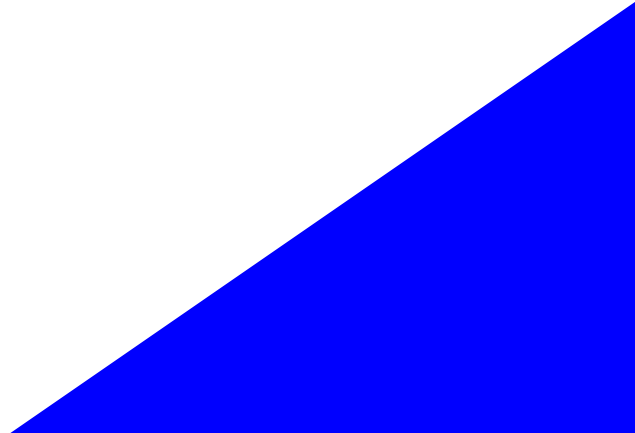


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« Appendix: EMR graphical rules »



Power
source



- light green background
RGB = (152,251,152)
« pale green »
- dark green border
RGB = (0,128,0)
« green »

Power
system



- orange background
RGB = (255,215,0)
« gold »
- red border
RGB = (255,0,0)
« red »

System
model



- purple background
RGB = (238,130,238)
« violet »
- dark blue border
RGB = (0,0,255)
« blue »

System
control



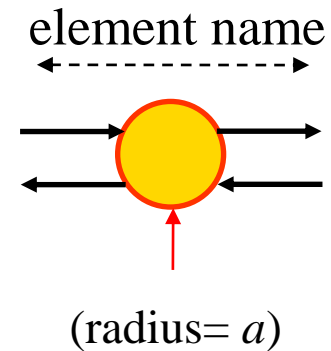
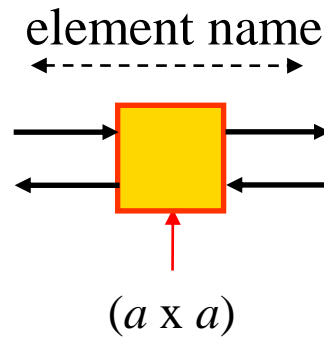
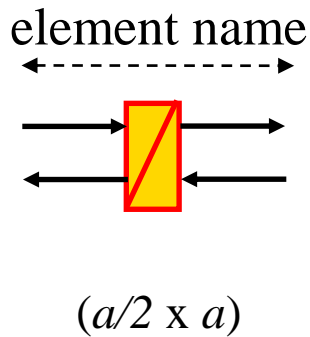
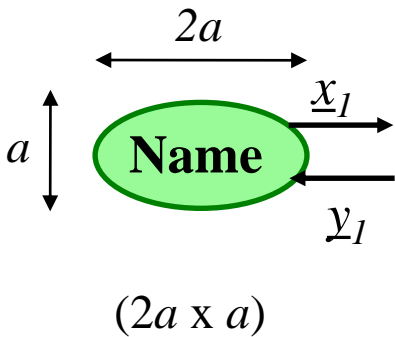
- light blue background
RGB = (135,206,235)
« sky blue »
- dark blue border
RGB = (0,0,255)
« blue »

Control
strategy



- dark blue background
RGB = (0,0,255)
« blue »
- dark blue border
RGB = (0,0,255)
« blue »

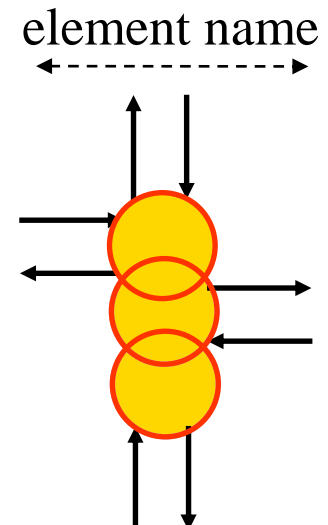
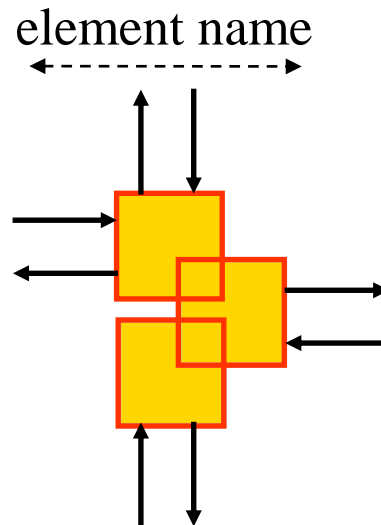
No equation number in slides

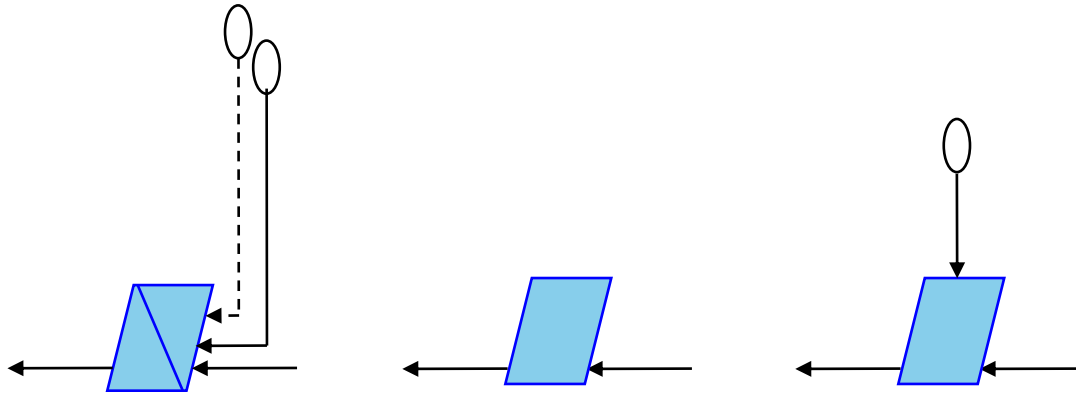


borders of power elements = b pt

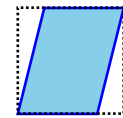
→ power vectors
(size b , full arrows)

↑ signal vectors
(size $b/2$, empty arrows)





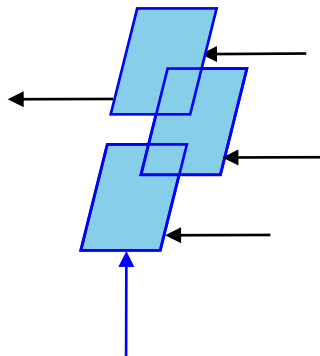
(same pictograms – same size -
with or without oblique bar)

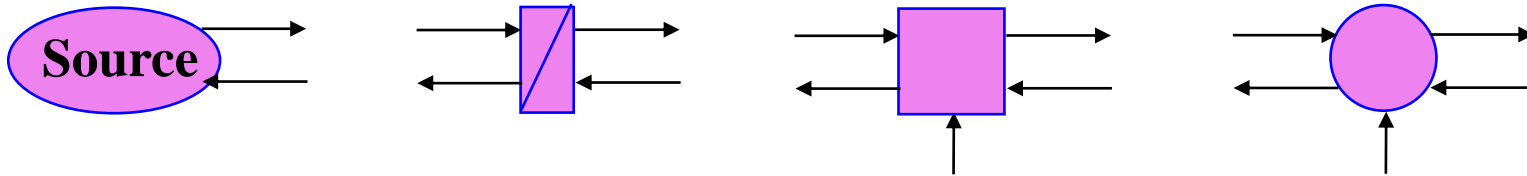


(support square
 $a \times a$)

borders of control
elements = $b/2$ pt

↑ signal vectors
(size $b/2$, empty arrows)





borders of estimation elements = $b/2$ pt

↑ signal vectors (size $b/2$, empty arrows)

