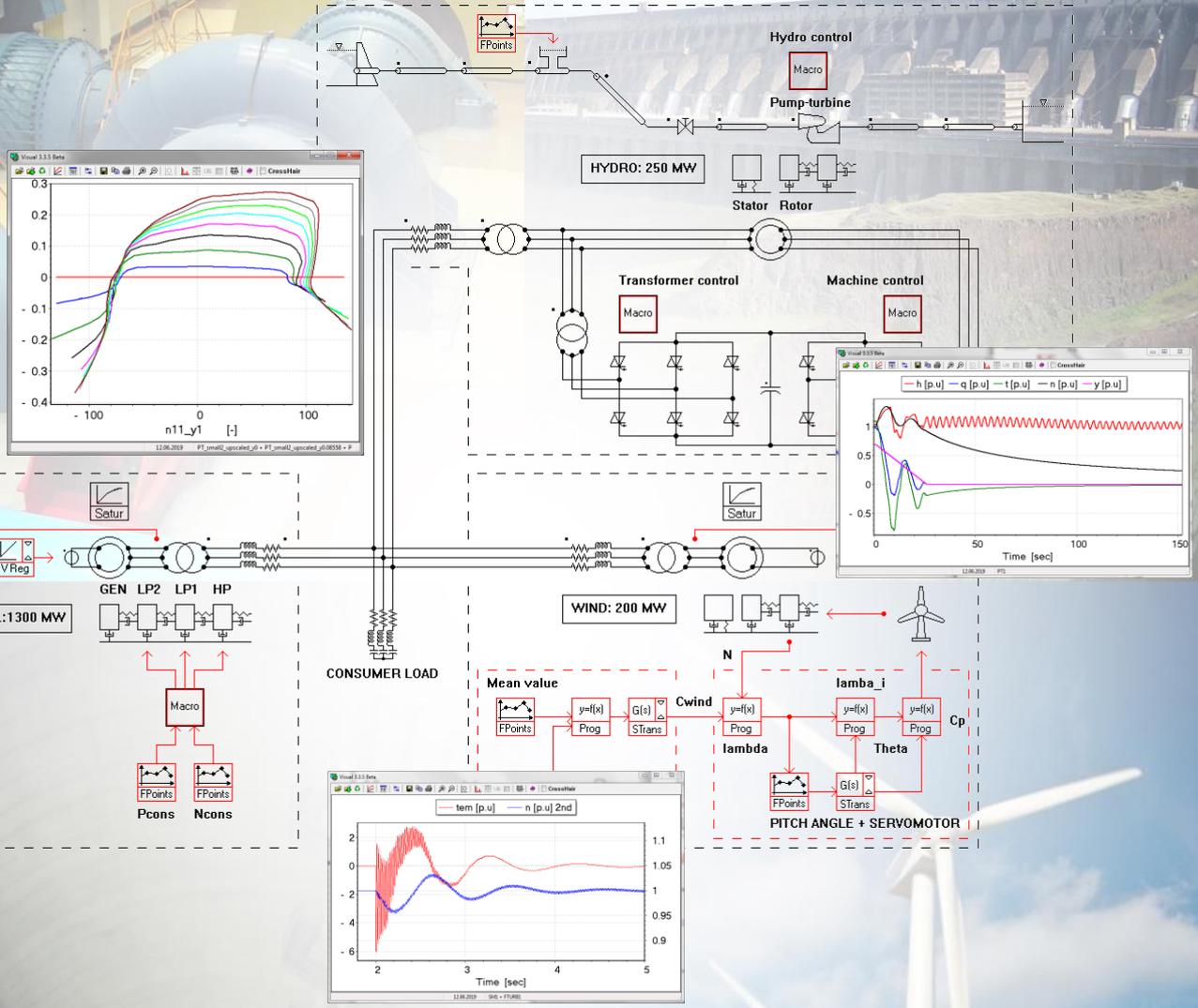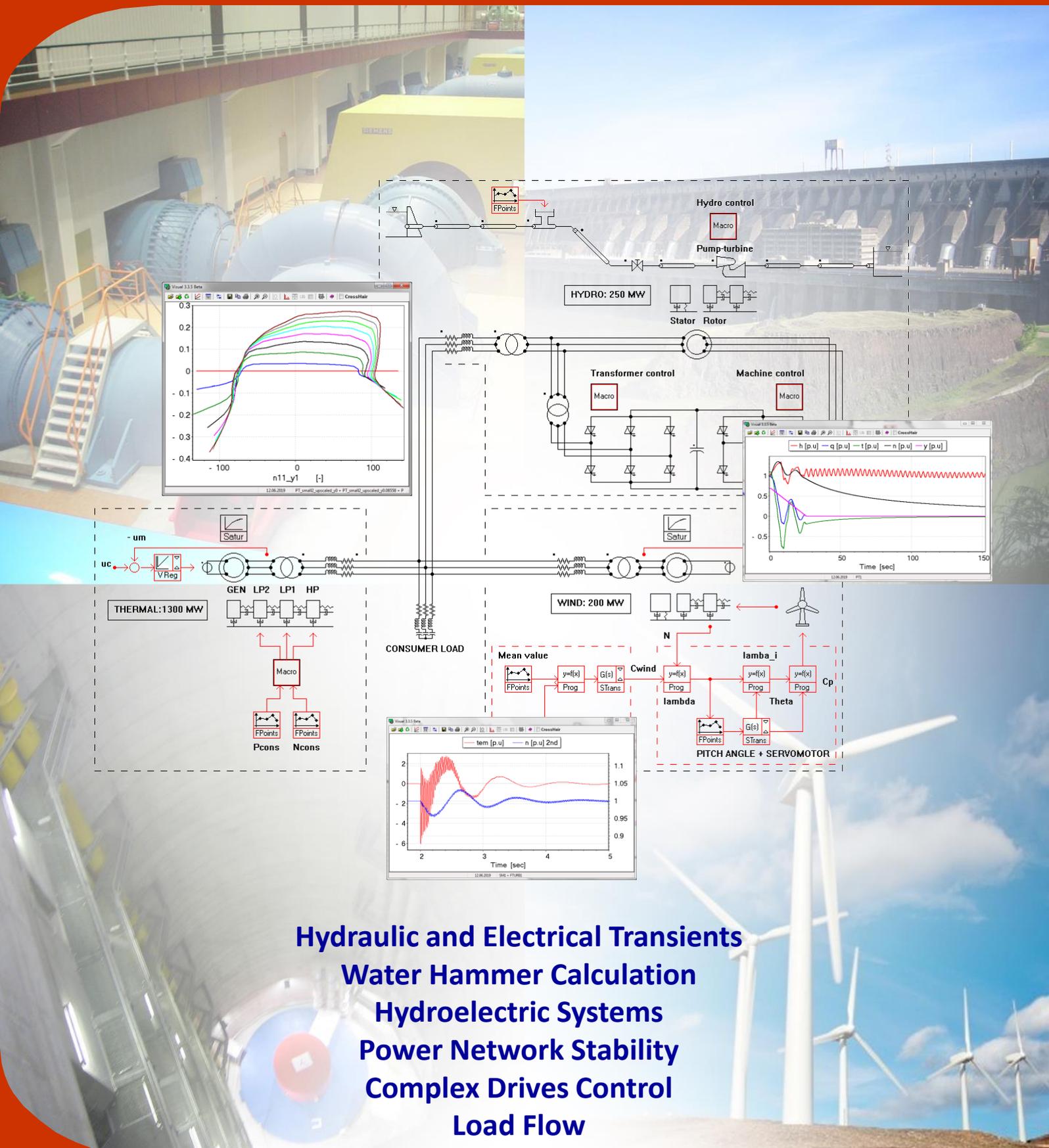# SIMSEN

**Simulation Software for Hydraulic & Electric Systems Adjustable Speed Drives**
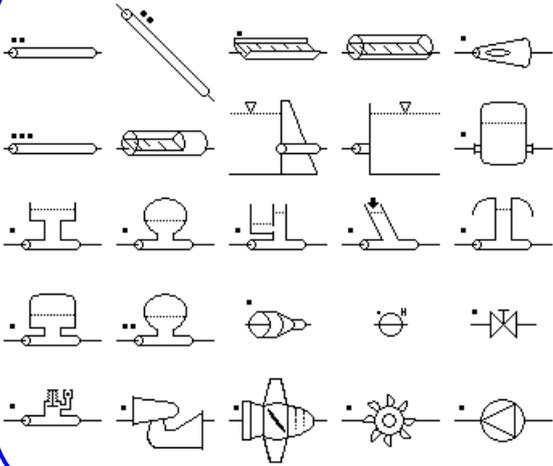


**Hydraulic and Electrical Transients
Water Hammer Calculation
Hydroelectric Systems
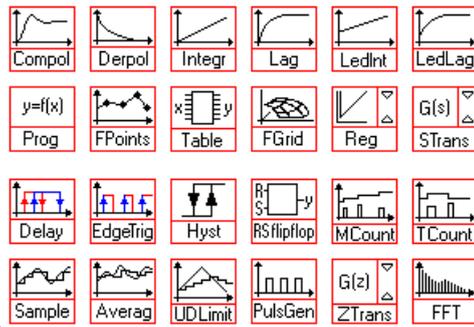Power Network Stability
Complex Drives Control
Load Flow**

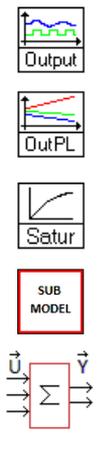# SIMSEN

## Libraries:

### Hydraulic Systems

### Analog & Digital Control Blocks

| Compol | Derpol | Integr | Lag | LedInt | LedLag |
| --- | --- | --- | --- | --- | --- |
| y=f(x) Prog | FPoints | Table | FGrid | Reg | G(s) STrans |
| Delay | EdgeTrig | Hyst | RSflipflop | MCount | TCount |
| Sample | Averag | UDLimit | PulsGen | G(z) ZTrans | FFT |

### Application Coupling

| y=f(x) Extern |
| --- |
| ExeLink |
| FMU |

### Special Units

| Output |
| --- |
| OutPL |
| Satur |
| SUB MODEL |
| $\vec{U} \; \Sigma \; \vec{Y}$ |

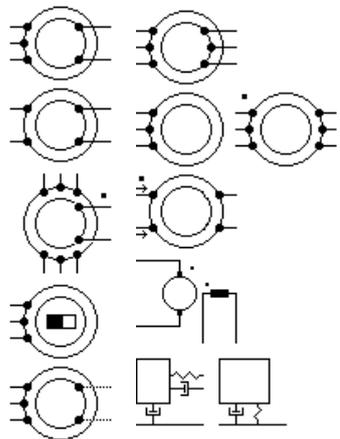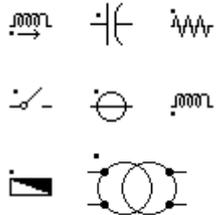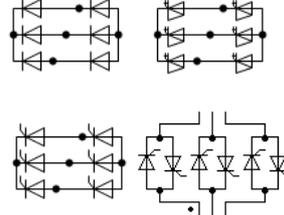### New Renewable and Average Converters

### Electrical Machines and Rotating Inertias

### 1 Phase Units

### 3 Phases Converters

### IEEE Standard Excitation Systems and PSS

| ST1A | ST4B | ST7B | PSS2B |
| --- | --- | --- | --- |
| AC8B | AC9C | ST8C | PSS4B |
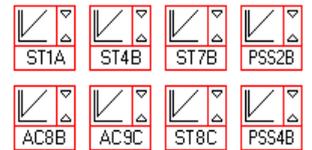
### 1 Phase Semi-Conductors
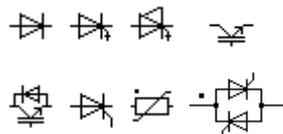
### 3 Phases Units
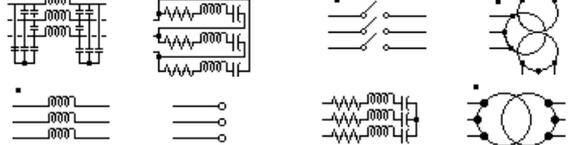
### Available libraries

- **Eigen values, eigen vectors calculation and representation**
- **Harmonic analysis**
- **Turbine characteristic pre-processing**
- **Coupling with CFX and ANSYS**
- **Water column separation**
- **Open channel**

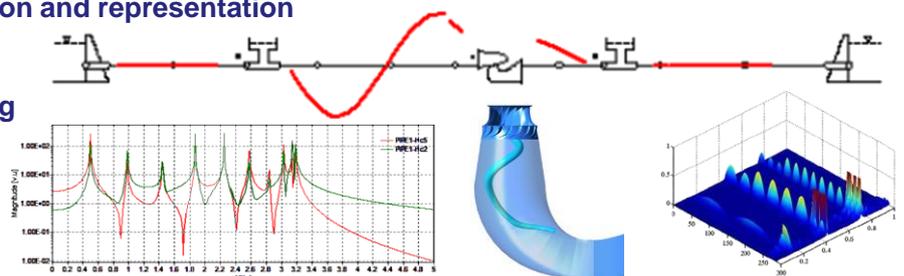# Simulation Software for Hydraulic & Electric Systems Adjustable Speed Drives

## Features:

- ✓ **From water to wire modelling**
- ✓ **Modular structure with arbitrary topology**
- ✓ **No restriction on the network size**
- ✓ **Three phases systems in ABC phase quantities**
- ✓ **Events detection and back-tracking**
- ✓ **Load-Flow calculation**
- ✓ **Parameterization**
- ✓ **Harmonics analysis, eigen values, eigen vectors calculation and representation**

## Hydraulic systems

- ✓ **Water hammer calculation**
- ✓ **4 quadrants transient behavior**
- ✓ **Francis/Pelton/Kaplan/Pumps and reversible Francis pump-turbines**
- ✓ **Surge tanks, surge shafts, differential surge tanks**
- ✓ **PID Turbine governors**
- ✓ **Hydroelectric interactions**
- ✓ **Cavitation/Water column separation**
- ✓ **Open channel flows**
- ✓ **Piezometric line visualization**
- ✓ **Database of realistic Francis & Pelton turbines performance hill chart**

## Graphical User Interface
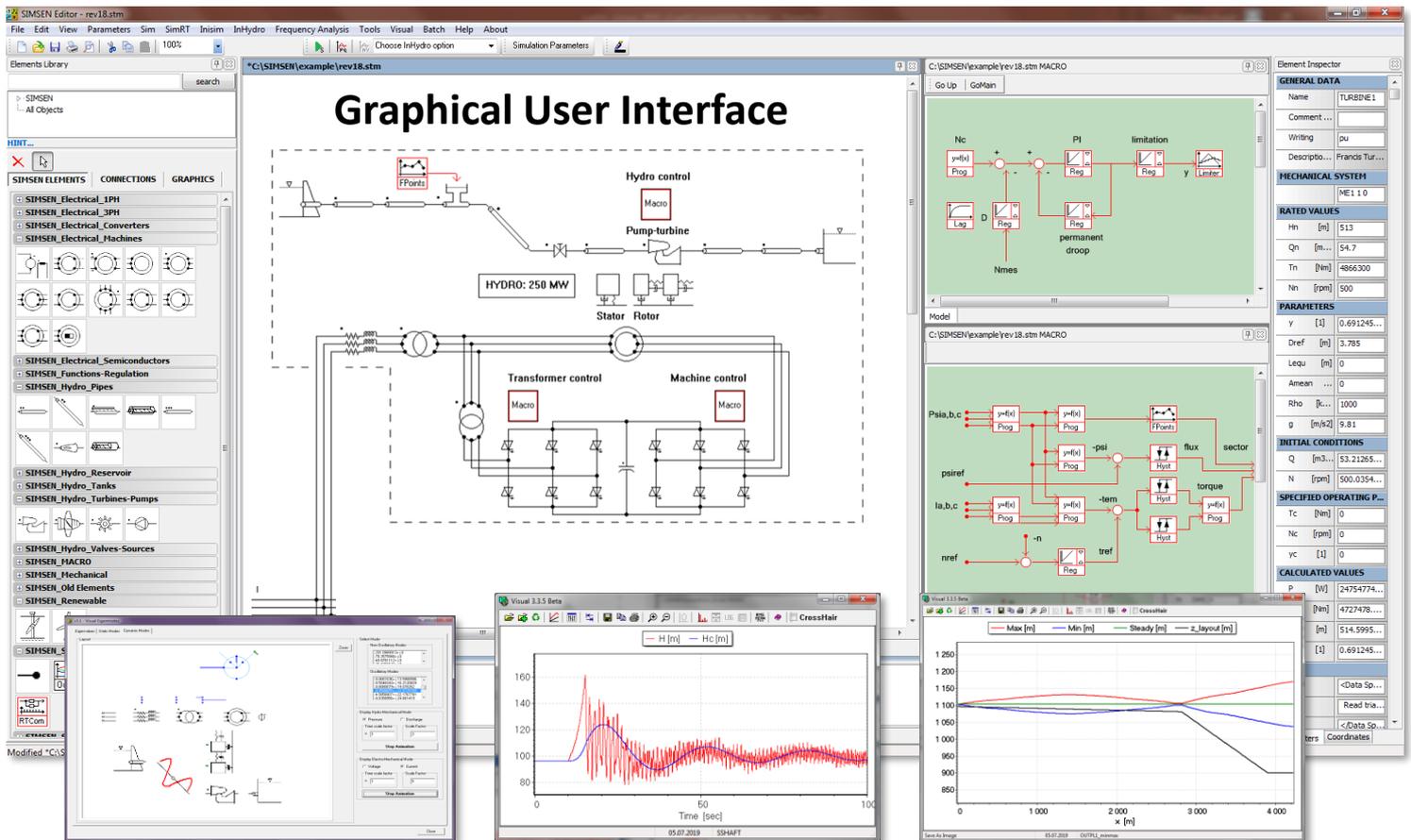


## Electrical Power Networks:

- ✓ **Electrical 3ph machines models 2.1-3.3 according to IEEE standard 1110**
- ✓ **Single phase synchronous machine model**
- ✓ **Electromagnetic transients in AC/DC**
- ✓ **Transient stability and general fault analysis**
- ✓ **SubSynchronous Resonance (SSR)**
- ✓ **Torsional analysis**
- ✓ **FACTS, HVDC, SVC**
- ✓ **Grid code compliance (FRT)**
- ✓ **IEEE Standard excitation systems and PSS**

## Regulation part:

- ✓ **Easy definition of any control structure**
- ✓ **S-transfer functions, PID regulator**
- ✓ **Programmable unit, logical table**
- ✓ **Digital devices, Z-transfer functions**
- ✓ **Control devices, on-line FFT**
- ✓ **User defined DLL for control**
- ✓ **Coupling with external application (Matlab, Labview, EMTP-RV, Electromagnetic/Fluid FEM, HIL, etc)**

## Adjustable Speed Drives:

- ✓ **DFIM FSFC modelling**
- ✓ **Power electronics converters**
- ✓ **Multi level modular converters (MMC)**
- ✓ **Voltage Source Inverters (VSI)**
- ✓ **LCI 6 and 12 pulses**
- ✓ **Cyclo-converters**
- ✓ **Analog / digital mixed signals simulation**
- ✓ **PWM PLL based control**
- ✓ **Vector control**
- ✓ **IGBT GTO Thyristor**

# SIMSEN

**Simulation Software for
Hydraulic & Electric Systems
Adjustable Speed Drives**

SIMSEN Research, Development,
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and Training ensured by:

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**Demo version available on: http://simsen.epfl.ch**