AQAI Simulator Interface Software

AQAI SIS

AQAI
SIMULATION CENTER MAINZ

AQAI SIS

CONTENTS:

SUITABLE FOR:

Full-Scale-Mannequins

Laerdal SimMan:

- 3G
- Essential
- Essential Bleeding
- LLAEP compatible Mannequins

[1] LLEAP software unifies the control of all PC operated Laerdal simulators. LLEAP brings simplicity to running simulation training and efficiencies to the management and development of scenarios.

AQAI SIS – General Information

SIS – Simulator Interface Software – is a modular software package which has been developed by AQAI to enhance the usage and the degree of realism of patient simulators. It adds several functions to the existing simulator software (like the instructor application of Laerdal). Some of these functions are present in the basic module and thus available in all different configurations:

- Patient definition
- Hemodynamic physiology
- Gas exchange and ventilation physiology
- Pharmacological models for cardiovascular drugs, pulmonary drugs, hypnotics, analgesics and muscle relaxants
- Scenario editor and player

Several modules enhance the function of the basic module and allow special simulation experiences. These modules can be used one by one or all together at the same time:

- Anaesthesia effects and BIS[2] simulation including interfaces to most common iv-syringe pumps
- Hemodynamic Monitoring and PiCCO[3] simulation
- Intracranial pressure simulation
- Blood gases simulation
- TestChest[4] - support of high end artificial lung

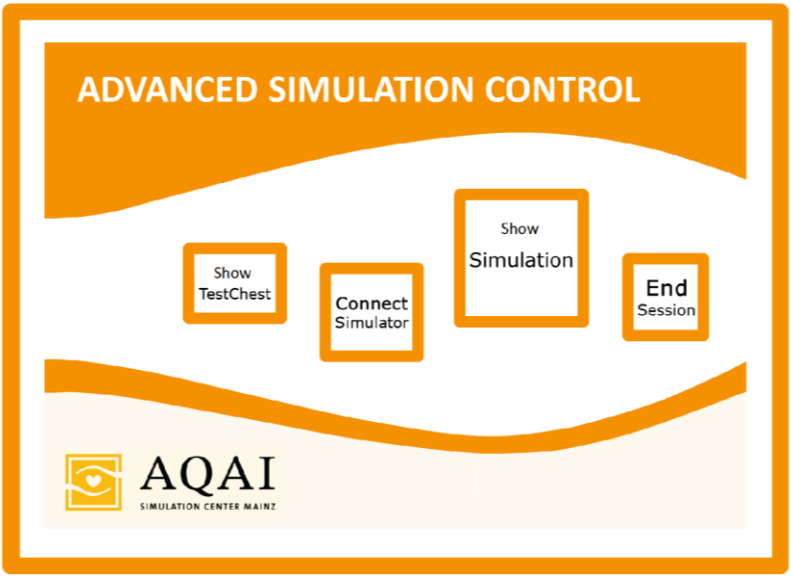
SIS is very flexible and will get more functions in the future.

[2] BIS = Bisprectral Index is a Trademark of Aspect/Covidien
[3] PiCCO is a Trademark of Pulsion/Maquet
[4] TestChest is a Trademark of Organis

SIS can be used on any Windows computer in 2 main interface modes:

- SIS Basic Mode (which is a more technical interface also used to develop cases and scenarios)
- SIS advanced mode (which is a full graphical web-interface and can run not only on Windows computers but also on any kind of tablet PC's or smartphones)

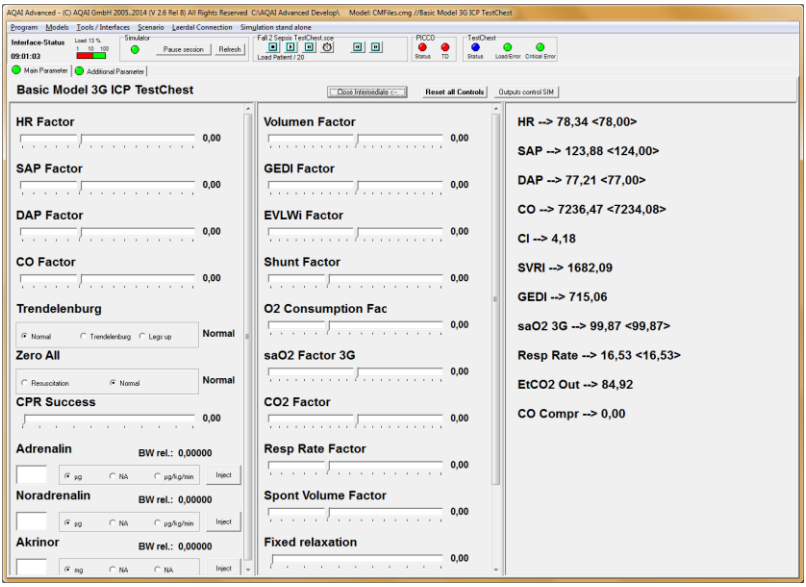
SIS starts with the following selection:



- Show TestChest: Start the interface for the TestChest artificial lung (if present).
- Connect Simulator: connect the software to an existing patient simulator

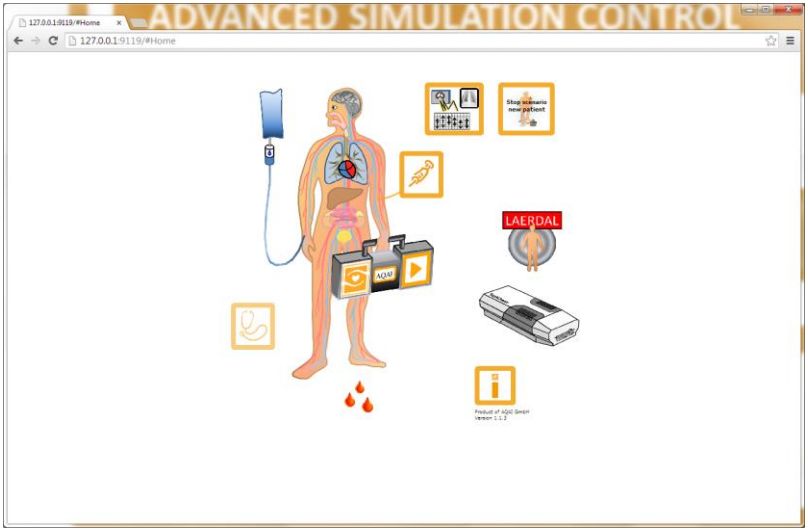
- Show Simulation: go to the basic mode
- End session: Leave the session.

SIS Basic mode is a technical interface to SIS. It can be used to start and run patients or scenarios and to influence the simulation parameters.



SIS Advanced mode is a full graphical web-interface. It shows a mannequin and several icons. Clicking on these icons will open more windows and thus allow for the full control of SIS including scenarios and a connected simulator (it is not necessary to work with the basic mode when using advanced mode).

SIS Advanced mode installs a webserver on the control PC. It can be configured as a Windows service; in this case it will always be available after startup of the PC and start of SIS. Clients can connect to this webserver using the IP-address of the control PC. If a Laerdal 3G family mannequin is present, it is possible to use the wireless router inside the mannequin for the connection of other computers, tablet PC's or smartphones as an access point.



AQAI SIS – Models and Modules

SIS realizes several models. These models have two functions: Every item can be set to a certain starting state (e.g. using the scenarios provided for various cases). Furthermore they can be influenced during the course of a simulation by "factors" which will increase or decrease the set point of the model. These Factors are available in the basic software as well as in the advanced graphical interface.

Patient definition

Patients can be defined by age, height, weight, body temperature and some more parameters. The data is used in the other models for adaptation. A special controller defines the sensitivity of the patient to anaesthesia or cardiovascular drugs. From this data the pharmacological models are modified to realize patients with higher or lower sensitivity to this kind of drugs.

Hemodynamic physiology

SIS features – as a central part of its models – hemodynamic reactions. SIS calculates the volumes in the various body spaces (like intra- and extravascular volumes, interstitial volumes). SIS supports various conditions like normotonic, hypertonic or hypotonic patients. In all cases drugs (s. below) work on these parameters and generate appropriate reactions.

Gas exchange and ventilation physiology

SIS uses oxygen consumption as the central parameter for the metabolism. Looking at the ventilation that is applied (spontaneously or artificial) and combining with the cardiovascular model, the oxygen delivery is calculated and balanced with the oxygen

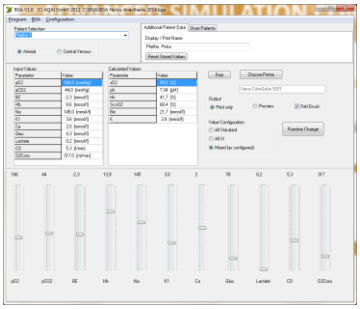
consumption. The lung function additionally uses models for dead space and intrapulmonary shunt (combined with extravascular lung water) to calculate the amount of oxygen uptake into the pulmonary arteries.

The gas exchange model can be used stand alone, together with the features of the mannequin or in the most advanced mode it is combined with the physiological models of gas exchange inside the TestChest.

Blood gas simulation

Based on the gas exchange information, SIS generates a blood gas analysis report. This blood gas analysis can be printed for the trainees or can be presented on the monitor application screen.

Blood gases can be modified by the instructor prior to the display or print. Thus metabolic changes or special considerations are under full control of the instructor.



Blood gas module of SIS

BGA - ZentralOP Arterial Name: Pfeiffer, Petra	
pO2	22,1 kPA
sO2	99,5 %
ph	7,33 pH
pCO2	5,9 kPa
Bic	21,7 mmol/l
BE	-2,3 mmol/l
Hb	8,6 mmol/l
Hk	41,7 %
Na	145,0 mmol/l
K	3,9 mmol/l
Ca	2,0 mmol/l
Lactate	0,2 mmol/l
Gluc	4,3 mmol/l

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AQAI BGA Simulation

Printout of blood gas report

Pharmacological models for cardiovascular drugs, pulmonary drugs, hypnotics, analgesics and muscle relaxants

All common drugs have immediate effects on the SIS physiological models and are realized in the pharmacological part of the system. Drugs are modelled using an open 3-compartment pharmacological model. The data of the models is adapted to the patient situation.

Drugs can be administered as a bolus (iv-push) application or continuously. If iv-syringe-pumps are used, the amount of drugs can be automatically feed into SIS by data links from the pumps to the control PC.

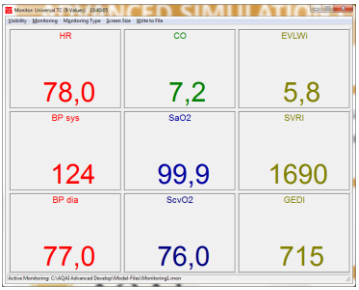
Anaesthesia effects and BIS simulation including interfaces to most common iv-syringe pumps

SIS supports special anaesthesia effects. This includes the calculation of drug interactions between hypnotics and narcotics as well as inhalational anaesthetics. As a result the model calculates a BIS value. This BIS value can be displayed on the patient monitor application or – using a special hardware interface – as a real EEG-trace analyzed by an EEG monitor. This way real anaesthesia monitors can be applied to simulation.

SIS has additional models for the support of TIVA-TCI (Total intravenous anaesthesia using target controlled infusion). In this setting, the trainee can work on the mannequin and the TCI pumps like in a real patient. SIS will talk to all these devices and calculate the appropriate reactions. Special learning modules for this kind of anaesthesia are available.

Hemodynamic Monitoring and PiCCO simulation

PiCCO is a system that uses transpulmonary thermo dilution and pulse contour analysis to realize a full hemodynamic profile of the patient. In SIS the identical models of PiCCO are integrated inside the cardiovascular model. Therefore it is possible to show all insides of the hemodynamic situation either on a real PiCCO monitor (using special demo software on this device) or on the patient monitor application or on a special monitor screen provided by SIS. The advantage of this monitor screen is that it can be recorded to the video system and the data can be used during debriefing.



Monitor output in SIS

Intracranial pressure simulation

Intracranial pressure results from any volume that is added to the intracranial space. SIS uses a volume / pressure model for the integration of neurological malfunctions resulting from increased intracranial pressure. This includes pupil control, cardiovascular control (e.g. Cushing's reflex), and respiratory control (e.g. decrease of intracranial pressure during hyper-ventilation or vice versa.

TestChest - support of high end artificial lung

AQAI Simulation Center Mainz, Germany, and Organis Landquart, Switzerland, have combined their experience in medical training, high-end technical design and mathematical modeling to create an innovative product: TestChest®

This high-end lung simulator is the ultimate tool for basic and advanced training for anesthesiologists, intensive care physicians and nurses. For the safety of patients in respiratory failure this training is just as important as flight simulator training is to pilots: it offers training in an environment where no harm will result to trainees or patients (passengers).

- TestChest eliminates the need for animal experiments and provides a breakthrough in training.
- TestChest realistically replicates pulmonary mechanics, gas exchange and hemodynamic responses.
- TestChest simulates respiration from normal spontaneous breathing to mechanically ventilated severely diseased lungs.
- TestChest is programmable and can be remotely operated to simulate in an unprecedented way the evolution of diseases as well as the recovery process.

AQAI has developed several learning modules especially designed for TestChest. The basic module "Artificial Ventilation - Basic" is part of every TestChest. All other learning modules use the Advanced Control Software which also contains preprogrammed scenarios for the various tasks. The user can work through the lectures step by step or can start at a certain level. In all cases TestChest is preprogrammed automatically with the correct reactions. Curves can be

derived from the ventilator or from the software which will present real-time graphs of flow, volume, pressure, gas exchange parameters and more. PowerPoint presentations explain the concepts of artificial ventilation. These presentations can be used to introduce a certain topic.

Currently the following learning modules are available:

- Ventilation Basics and Advanced
- ARDS
- COPD
- Weaning
- Noninvasive Ventilation
- Transpulmonary Pressure

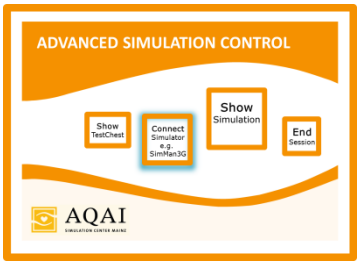
Furthermore, SIS has developed an interface to the SimMan3G family. The advanced features of TestChest can thus replace the more basic respiratory functions inside the mannequin.

This combination allows full-scale simulating experiences for any kind of respiratory training courses that cannot be realized with any other simulator. Any kind of respiratory support is possible in intensive care as well as in anesthesia and emergency medicine. All common functions of the full-scale mannequin remain active, e.g. heart and breathing sounds, pulses, airway features and resuscitation.

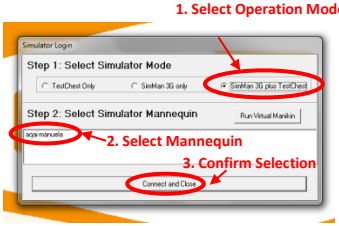
AQAI SIS – Combining SIS with Laerdal SimMan 3G / Essential / Essential Bleeding

In principle SIS can be connected to any kind of Full-Scale Mannequin in the same way. You have to run and control the instruction software of your Full-Scale Mannequin in parallel. However the synchronized features are available with the Laerdal Mannequins SimMan 3G / Essential / Essential Bleeding only.

Of course you are still able to use the instruction application of your SimMan 3G / Essential / Essential Bleeding as well. All changes done in the instructor application will be recognized by the Advanced Software Control. For example you may use the Laerdal RFID-Tags for Drug Application.



Press Connect Simulator



Select Mannequin and connect

The Mannequin is now under control of the Software and all parameters will be continuously synchronized with SIS. You may select “Show Simulation” and control the Simulation directly at the server application.

The web application can be launched additionally or if installed as service, it will be started with the start of your server PC and you can directly launch your web browser on any device (capable of running a web browser).

A Laerdal session can be started / resumed either in the Laerdal instructor application itself, in the SIS interface using "Show Simulation" or in the graphical interface.

Using this interface the Laerdal mannequin will get interesting new features. The models of SIS will be active. Thus e.g. drugs will have effects. If Propofol is administered, the mannequin will react to this by closing the eyes, decreasing the ventilation. If the BIS module is present, the BIS will react appropriately and moreover the cardiovascular response of Propofol can be seen on the patient monitor. The same is true for other drugs, for bleeding, volume therapy and much more.

If the TestChest is used the complete gas exchange will be modeled and give realistic responses to the way of ventilatory support the user applies to the mannequin. TestChest realizes spontaneous active breathing. The ventilator connected to the SimMan will be triggered. It is possible to use all modes of ventilation on the mannequin, even those with very high pressures (PEEP). In all cases SIS takes care, that chest movement and lung sounds are correctly triggered.

AQAI – SIS: Combining SIS with Laerdal LLEAP

LLEAP by Laerdal is a new platform for the control of a variety of simulators with a single user interface.

This exciting software package has recently been released by Laerdal. AQAI provides a universal interface from SIS to LLEAP. Thus the functions of SIS and the AQAI Advanced Software are available on all Laerdal mannequins, which support LLEAP.

LLEAP has a variety of new and fascinating features. They all stay active and can be used in parallel to the SIS functions. In fact LLEAP is always seen as the "master-controller", but SIS may take over part or all functions of LLEAP.

Currently several manikins can be equipped with LLEAP: from the SimNewB newborn simulator via Sim Junior being a 6 years child to the adult manikins ALS-simulator, SimMan and even SimMom (the birthing simulator). They all can be controlled via SIS and SIS learns automatically the individual properties of these simulators and adapts its models appropriately.

Furthermore, AQAI has developed several add-ons for the combination of any LLEAP simulator with the TestChest® (not possible for SimNewB). These add-ons take care that the movement of the thorax as well as the synchronization of the breathing sounds are coordinated by the TestChest® signals. The result is a perfect experience of simulation manikins with an absolute realistic lung model.

AQAI – SIS plus TestChest® plus LLEAP = High-end simulation

AQAI SIS, TestChest®, State of the art ventilator,

AQAI Learning Modules:

“Respiratory Therapy – Get the black box off”