Making Childbirth Safer

- **French robotic medical research project**

- **Innovative childbirth simulator for training obstetricians and residents**

- **Practicing diagnostic and therapeutic manipulations**

Obstetricians and residents (trainee doctors) learn most of their craft in the delivery room itself. If problems occur during a birth, they use forceps and vacuum extractors to solve them, but this increases the risk of injury to mother and child. The only way this risk can be reduced is by years of practical experience. Soon, however, obstetricians and gynecologists will be able to hone their skills outside the delivery room, trying out manipulations on a new birth simulator called BirthSIM. ControlDesk and MotionDesk from dSPACE's experiment software family are used to control and visualize simulated birth complications.

The patented birth simulator, BirthSIM, is being jointly developed by the Laboratoire Ampère of the Institut National des Sciences Appliquées (INSA) and the Hospices Civils de Lyon, both in Lyon, France. It teaches trainee obstetricians and residents how to handle instrument placement when complications occur during birth.

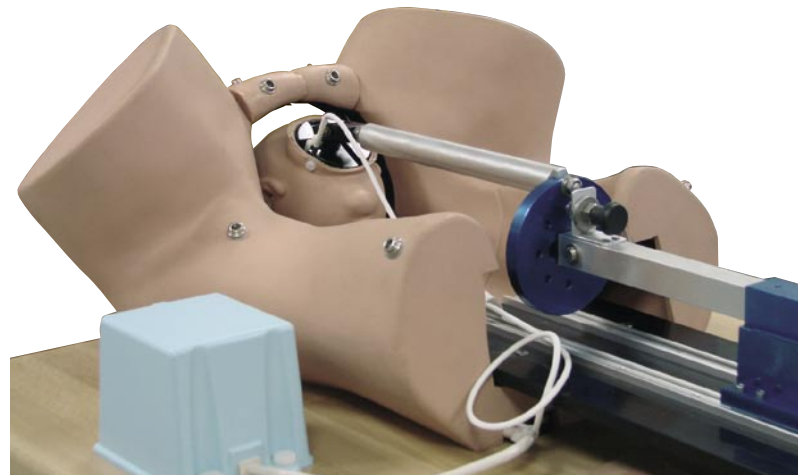### The Structure of BirthSIM

BirthSIM has electromagnetic sensors with 6 degrees of freedom. 3-D visualization shows images of the pelvis interior, including the position of the baby and the movements of the instruments. The control system, with the DS1005 PPC Board at its core, processes the data captured by the sensors. To be more precise, it picks up the data on the forceps' position, calculates the position of the forceps model by MATLAB®/Simulink®, and passes the information to MotionDesk, which registers the forceps' trajectory and then replays the scenario on the monitor. BirthSIM consists of the following components:

- Static mechanical system: anatomical models of the mother's pelvis, the pelvic floor muscles, the baby's head, and real forceps.
- Dynamic mechanical positioning system: for modifying the baby's position in the womb.

- Two monitors: The first is for the instructor. It runs with ControlDesk to visualize and parameterize the birth complications to be simulated. The second works with MotionDesk and gives obstetricians in training the opportunity to observe the movements of their instruments inside the pelvis in real time. Visualization is performed from several perspectives.

BirthSIM Indispensable to Training

To date, there are no comparable anatomic simulators for obstetrics that provide a comprehensive learning program for training obstetricians and residents on a mechatronic basis. To close this gap, our team from the Laboratoire Ampère conceived and developed the BirthSIM simulator, with the aim of replacing existing

This year the Foundation Rhône-Alpes-Futur gave the first award to Dr. Dupuis in recognition of his commitment to the collaboration between research and hospital and his contribution to the development of the childbirth simulator.

Ampère

http://ampere-lab.fr

▲ *A mechatronic system developed at the Laboratoire Ampère positions the baby's head in the pelvis by rotation and translation.*

obstetric simulators with it. BirthSIM is a new type of simulator that gives obstetricians and residents a means of practicing instrument use, so inexperienced delivery room staff can be trained without endangering the health of patients.

BirthSIM's Current Development Status

At its current stage of development, BirthSIM helps to train the following manipulations:

- Diagnostics via internal examination through the vagina
- Analysis and reproducibility of actions involved in using forceps, via an interface developed with MATLAB/Simulink
- Evaluation and analysis of forceps handling according to criteria selected by the medical team
- Learning to apply forceps in the right place, without harm to baby and mother, supported by MotionDesk visualization

BirthSIM in the Future

The prototype of the simulator has been available in the Centre Hospitalier Universitaire de Lyon Sud of the Hospices Civils de Lyon since June 2007. Dr. Olivier Dupuis, specialist gynecological obstetrician, has made it part of the curriculum for gynecologists. Meanwhile, the Laboratoire Ampère is continuing work on developing the simulator. The goal is to position the baby's head in the birth canal by moving and rotating it. Simultaneously, an electropneumatic system will reproduce the expulsion forces that occur during birth (contractions and the mother's intentional pressure). Obstetricians can then learn to synchronize forceps traction with the mother's natural expulsion forces. Initial results already showed that an obstetrician who trained on BirthSIM applies far less force to the baby's head during a forceps birth, the overall effect of which is to make the delivery procedure safer and less risky.

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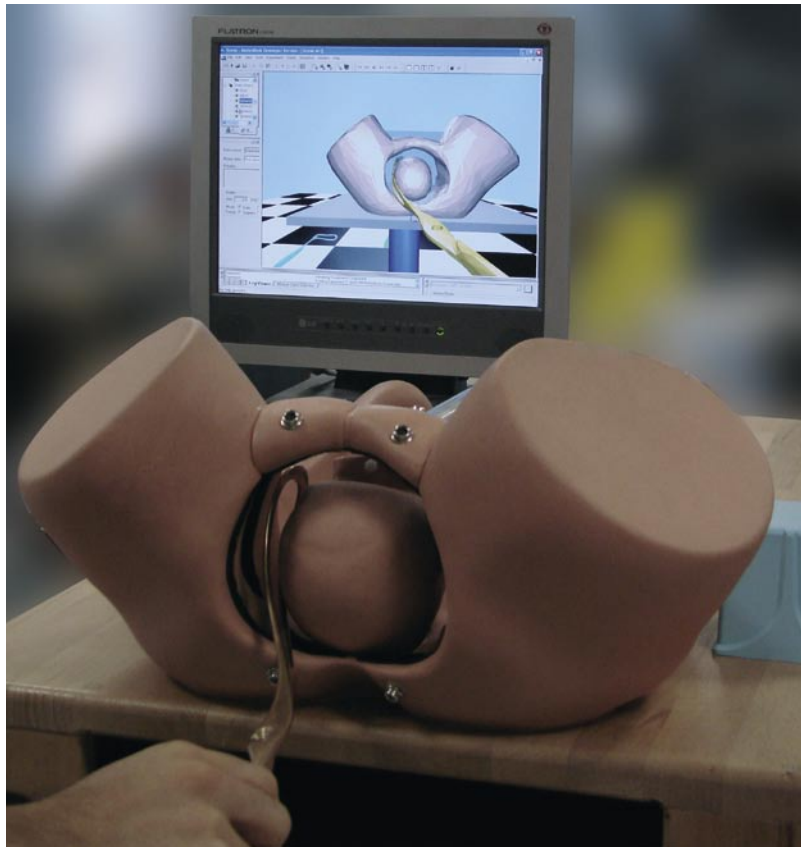
▲ *Obstetricians and residents can practice using forceps on BirthSIM.*
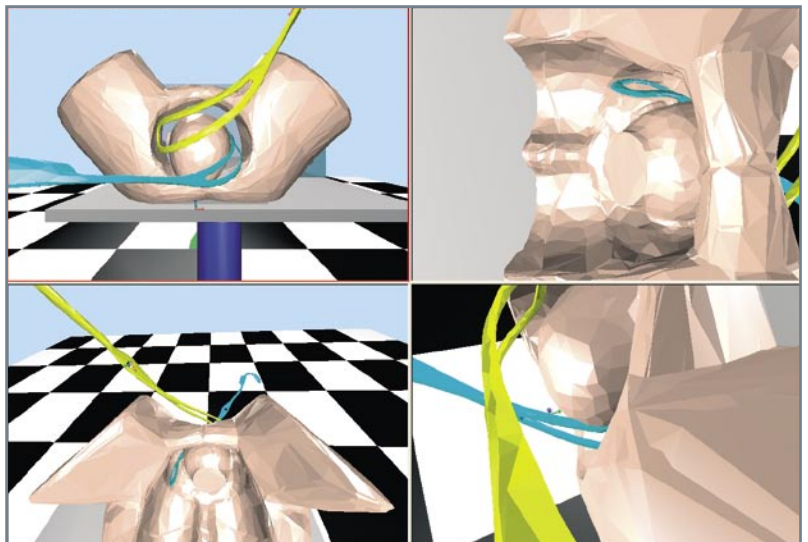
▲ *On-screen monitoring: MotionDesk visualizes forceps insertion from several perspectives. The 3-D visualization is useful for analyzing the handling and for recording typical mistakes.*