

# Multimodal Environments for Simulation and Training

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# Rezumat

- **Despre mine & Univ. Armstrong Atlantic**
- Posibilitati de parteneriat
  - Vizite studenti si cadre didactice
  - Colaborari legate de cercetare
- Domenii/Teme de cercetare

# Despre mine - educatie

- Absolvent E. Gojdu ('94)
- Univ. Tehnica Cluj-Napoca ('99)
  - B.Sc. Computer Science
  - M.S. Computer Science (partial)
- Univ. of Central Florida
  - M.S. Computer Science ('01)
  - M.B.A (partial)
  - Ph.D. Computer Science ('04)
- Pe scurt
  - 40 publicatii (10 Journals, 30 Conferintze peer-reviewed)
  - 9 demonstratii prototype – US/Germania
  - 1 Patent

# Despre mine – experientza

- Hafix SRL – Oradea (95-99)
  - Programator
- U.T. Cluj-Napoca (98-99)
  - Designer Interfete Software – Tempus Phare – e-Learning Systems
- Data Management Systems – Paris (99-00)
  - Dezvoltare si Integrare Software
- Nivis LLC – Atlanta (00)
  - Manager Proiecte
- Univ. of Central Florida – Orlando (00-02)
  - Research Assistant
- Univ. of Central Florida – Orlando (02-04)
  - Research Associate / Professor (temp) – Computer Science
- Tirrion LLC – Orlando (04-06)
  - Director Tehnic
- Armstrong Atlantic State University (06-prezent)
  - Professor (post permanent – tenure track)
  - Director Network Enabled WorkSpaces Laboratory (NEWS Lab)

# Armstrong Atlantic University (est. 1935)

- Georgia State University System
  - 12 Universitati de stat (pop. GA 10 mil)
- Locatie
  - Savannah City – pop. 150 mii / reg. 250 mii
- Populatie AASU
  - Approx 7,000 studenti si 290 angajati
- Suprafatza campus
  - 110 Hectare
  - Terenuri de sport, Complex conferintze etc.

# Armstrong Atlantic University (facultati)

- College of Arts and Science
  - Arta, Muzica si Teatru
  - Biologie
  - Chimie si Fizica
  - Justitie Criminala, Stiintze Politice si Sociale
  - Istorie, Literatura si Filozofie
  - Matematica
  - Psychologie
- College of Education
  - Educatia copilului
  - Educatia sanatatii si fizica
  - Educatie pt. adulti si speciala
- College of Health Professions
  - Igiena Dentara
  - Stiintza Sanatatii
  - Tehnologie Medicala
  - Asistentza Medicala (Nursing)
  - Terapie Fizica
  - Radiologie
  - Terapie Respiratorie
- School of Computing
  - Computer Science (Accreditation Board for Engineering and Technology – ABET accredited)
  - Information Technology
  - Engineering
- School of Graduate Studies

# Rezumat

- Despre mine si despre Univ. Armstrong Atlantic
- **Posibilitati de parteneriat**
  - Vizite studenti si cadre didactice
  - Colaborari legate de cercetare
- Domenii/Teme de cercetare

# Posibilitati de Parteneriat

## 1. Vizite studenti/cadre didactice

- Vizite studenti/cadre didactice
  - pt. experientza culturala
  - perioada de vara: Mai, Iunie, Iulie
  - durata: 2-3 saptamani (pt. studenti US)
- Activitati (pt. studenti US)
  - Un curs f. scurt - istoria orasului & a Romaniei
  - Un curs f. scurt tehnic (oferit de mine)
  - Excursii in zona
  - Activitati sociale (cu studenti romani)

# Puncte pt. Stabilire Parteneriat

- Sala de clasa
- Asistentza locala pt.
  - Transport
  - Cazare/Mancare
  - Ghidare (zone turistice) etc.
- Implicarea studentilor/cadre didactice

# Posibilitati de Parteneriat

## 2. Cercetare

- Domenii
  - Sisteme Distribuite
    - Retele / Internet / Protocoale de Securitate
  - Human Computer Interaction
    - Realitate Virtuala
    - Sisteme Multimodale (cu achizitionare in timp real)
    - Interfete Grafice (Web etc.)
  - Baze de Date
    - Data mining

# Posibilitati de Parteneriat

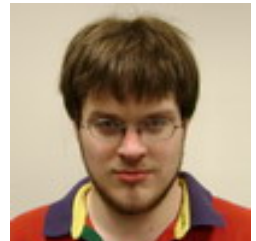
## 2. Cercetare



Michelle



Markus



James

**NEWS**  
Network Enabled WorkSpaces



Ivan



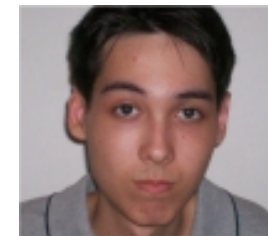
Simona



Carlos



Donna



Eric

## Recent Funding

<b>Funding Agency</b>	<b>Amount</b>	<b>Info</b>	<b>Project</b>
M.D Anderson Cancer Foundation Orlando	\$10,000	Seed research grant	3DRTT
Radiological Society of North America	\$30,000	Seed grant	3DRTT
Konica-Minolta 3D Scanning Systems	\$3,000	Free 3D scanning	3DRTT
Faro Technologies Orlando 3D Scanning	\$3,000	Free 3D scanning	3DRTT
Armstrong Atlantic State University	\$1,900	Research & Scholarship Grant	3DRTT
Mercer Medical School (Savannah Campus)	\$13,600	Development of Advanced Educational Materials.	Neuro Pathways
Armstrong Atlantic State University	\$2,400	Research & Scholarship Grant. Interdisciplinary (with Psychology) B.R. Sturz (PI).	BACH
Armstrong Atlantic State University	\$2,460	Teaching & Learning Grant. Interdisciplinary (with Engineering Studies) P.T. Goeser (PI).	VIEW

# Posibilitati de Parteneriat

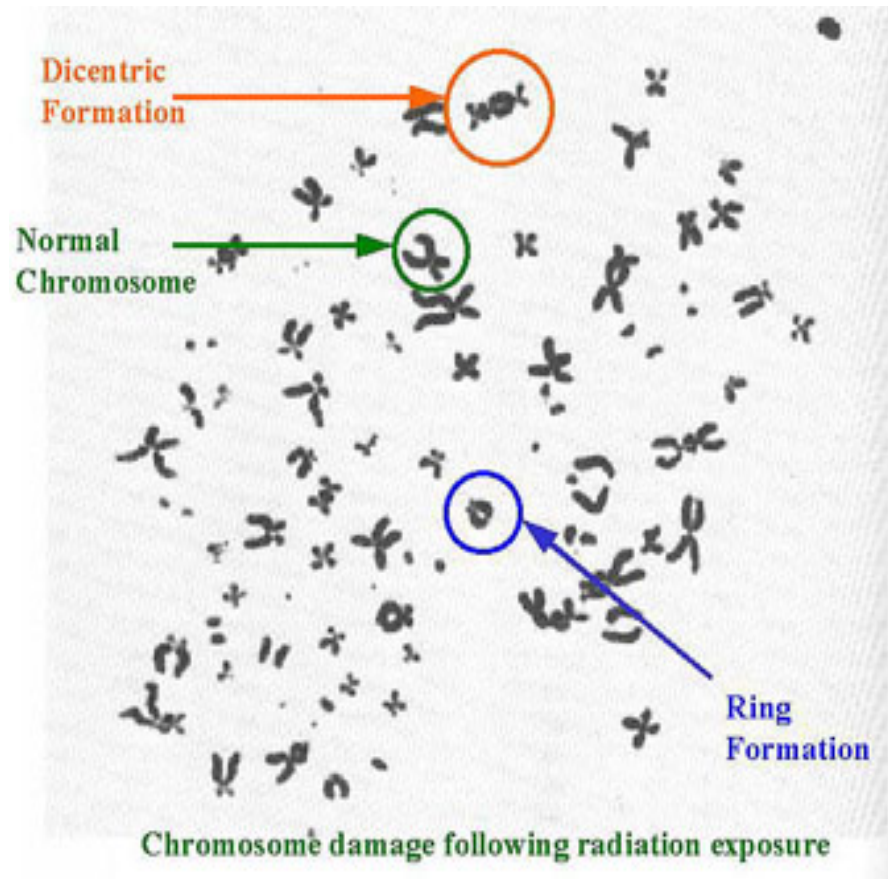
## 2. Cercetare

- Aplicatii (Proiecte)
  - Medicina
    - 3DRTT (Terapie cu Radiatii – Oncologie)
    - 3DRDV (3D Radiation Dosage Visualization)
    - Neuro Pathways (e-Learning Sistemul Nervos)
  - Fizica & Chimie
    - Simulare fenomene si procese (e.g. electroliza)
  - Ingineria Materialelor
    - VIEW (Virtual Interactive Engineering on the Web)
  - Robotica si Control la Distantza
    - BACH (Broadband Analysis of Collaborative Haptics)

# 1. Oncology & Radiation Therapy (3DRTT)

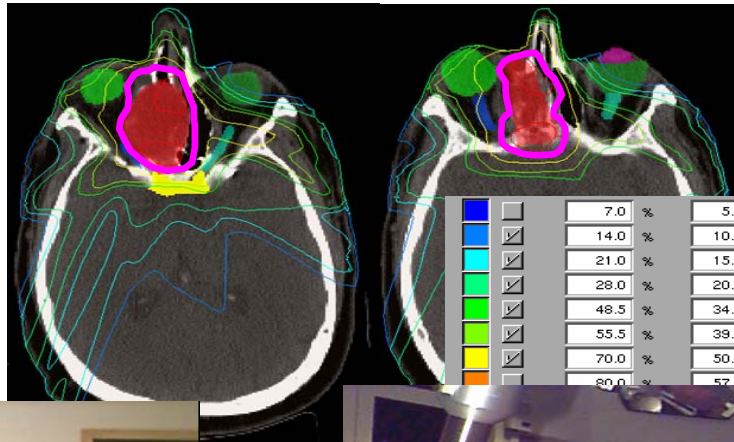
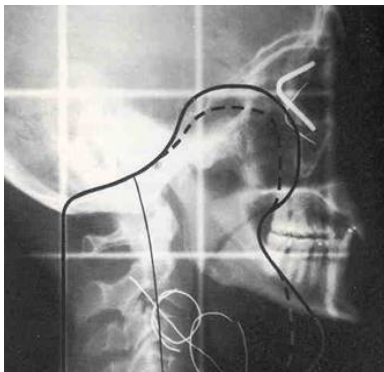
## Colaborare cu MD Anderson Cancer Foundation

Radiation destroys the cancer cells' ability to reproduce and the body naturally gets rid of these cells.



# Planificarea procedurii

- Calibrarea surselor de radiatii
- Calcularea dozelor de radiatie (dosimetristi)
- Fixarea pacientului ...



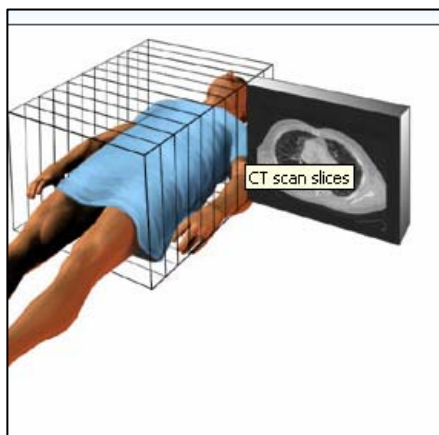
# General Flow of External Radiation Therapy Treatments



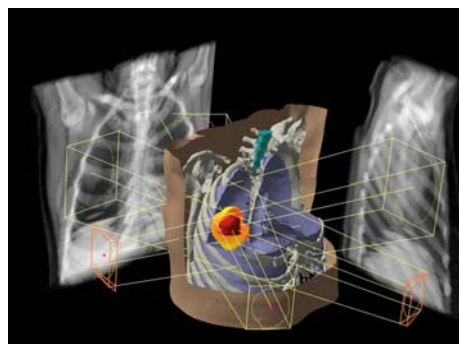
CT scanner



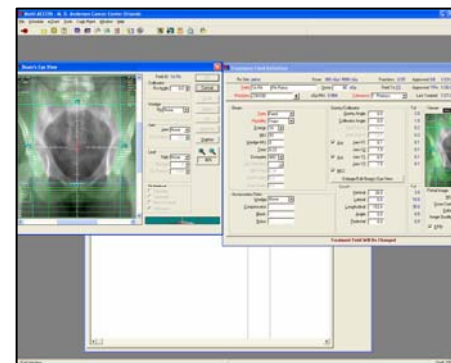
Linac:  
external beam  
treatment



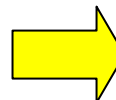
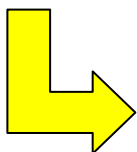
CT Slices +  
Radiation Therapy (RT) info



Treatment Planning System (TPS):  
dose calculation and visualization

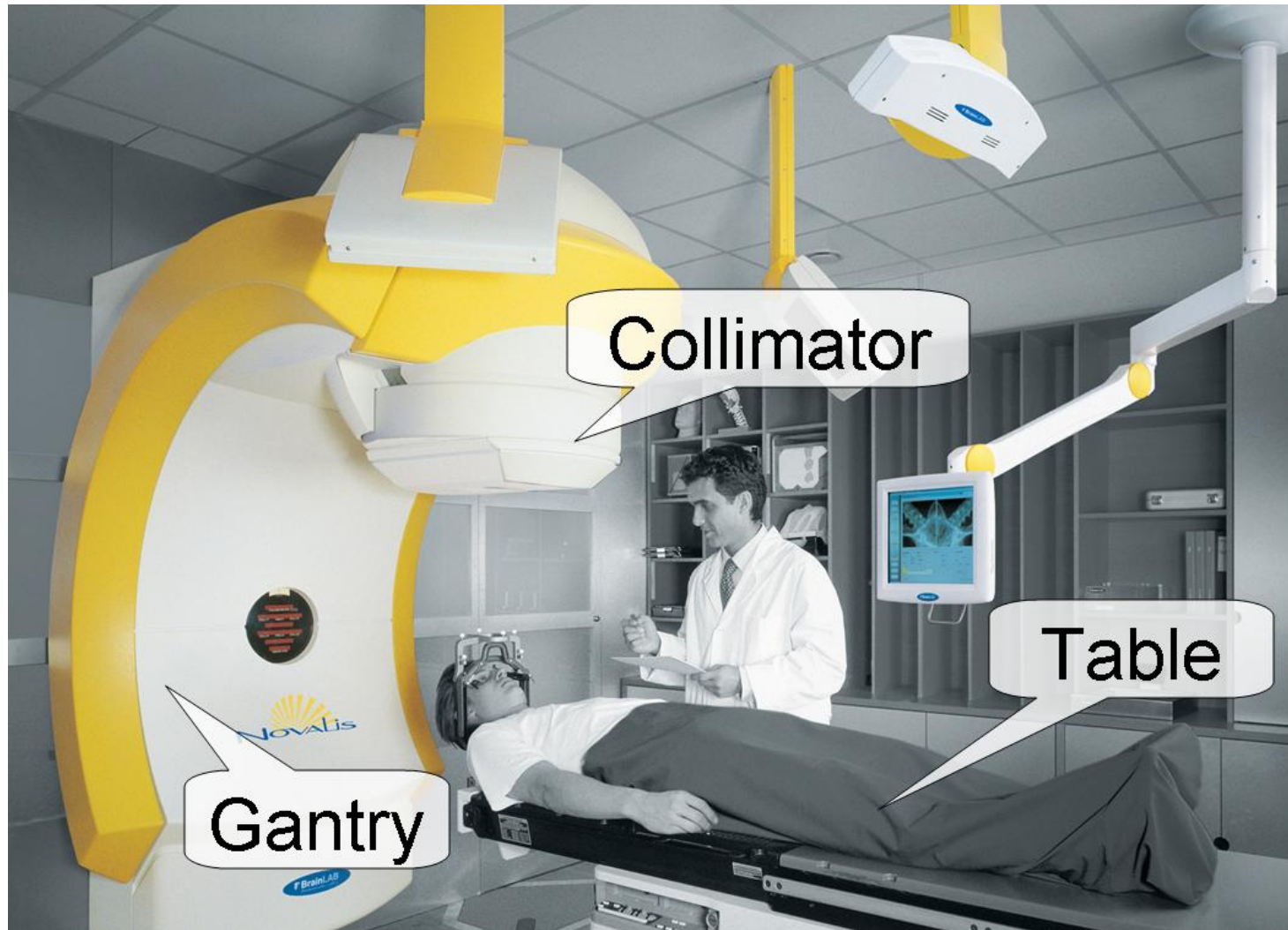


Record and Verify System (RV):  
makes sure all parameters are  
properly transferred to/from linac

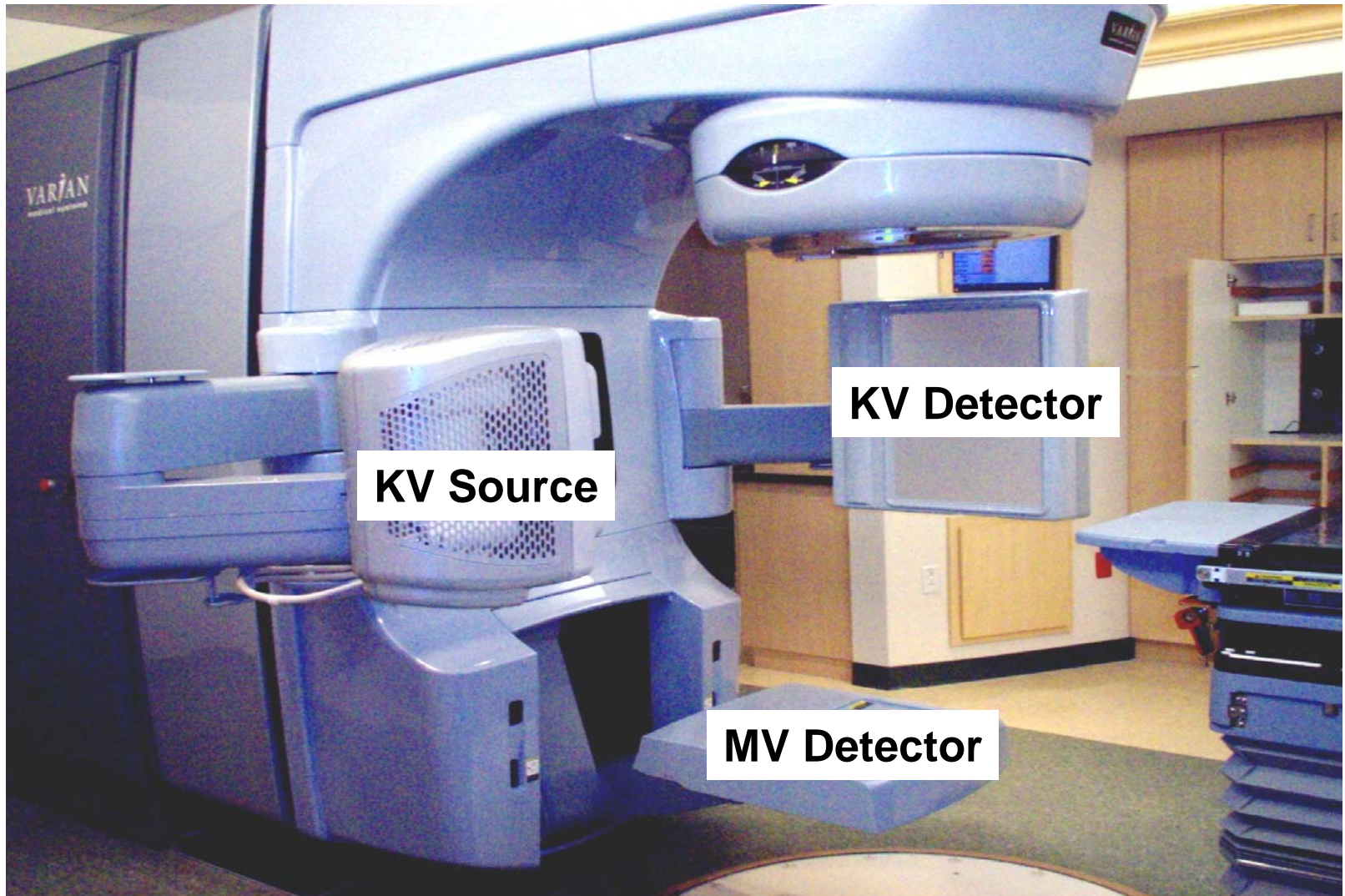


# LINACS (Novalis <sup>TM</sup>)

- LINear ACcelerator main components

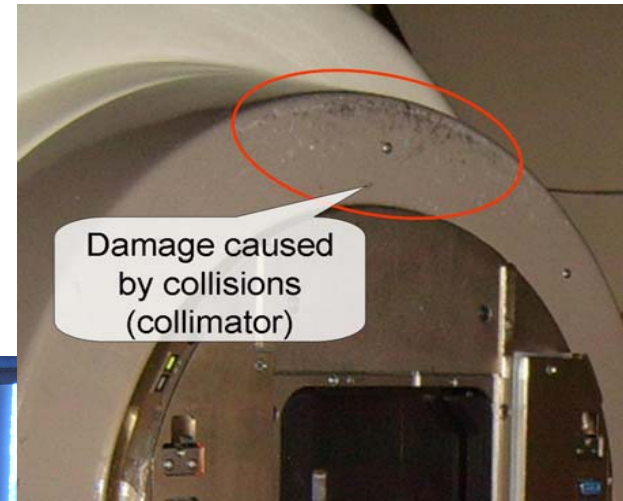


# LINACS (*Varian Trilogy™*)



# Probleme ce scapa planificarii

- Hardware Collisions
- Beam intersection with external objects



*“A typical situation from our clinic”* – MD  
Anderson Cancer Center Orlando  
Novalis 7-field H&N RT



needs a new  
paint job!

Beam Parameters:

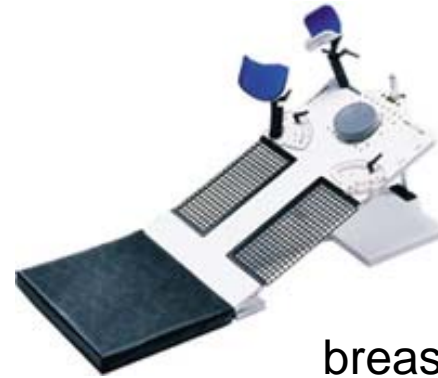
Gantry = 245°  
Couch = 350°  
Collimator = 0°  
VRT = 10.0  
LAT = **0.0**  
LNG = 60

*In many cases the collimator is touching the couch, and re-planning is required*

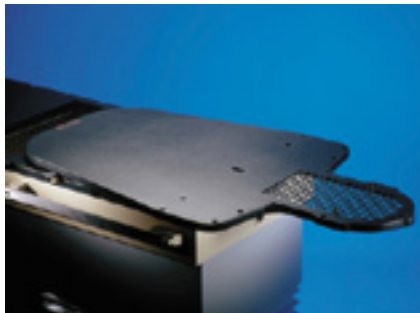
# Componente de fixare care pot genera coliziuni sau intersectii cu razele



stereotactic head frames



breast boards



head extensions



wing boards

# Motivatia proiectului

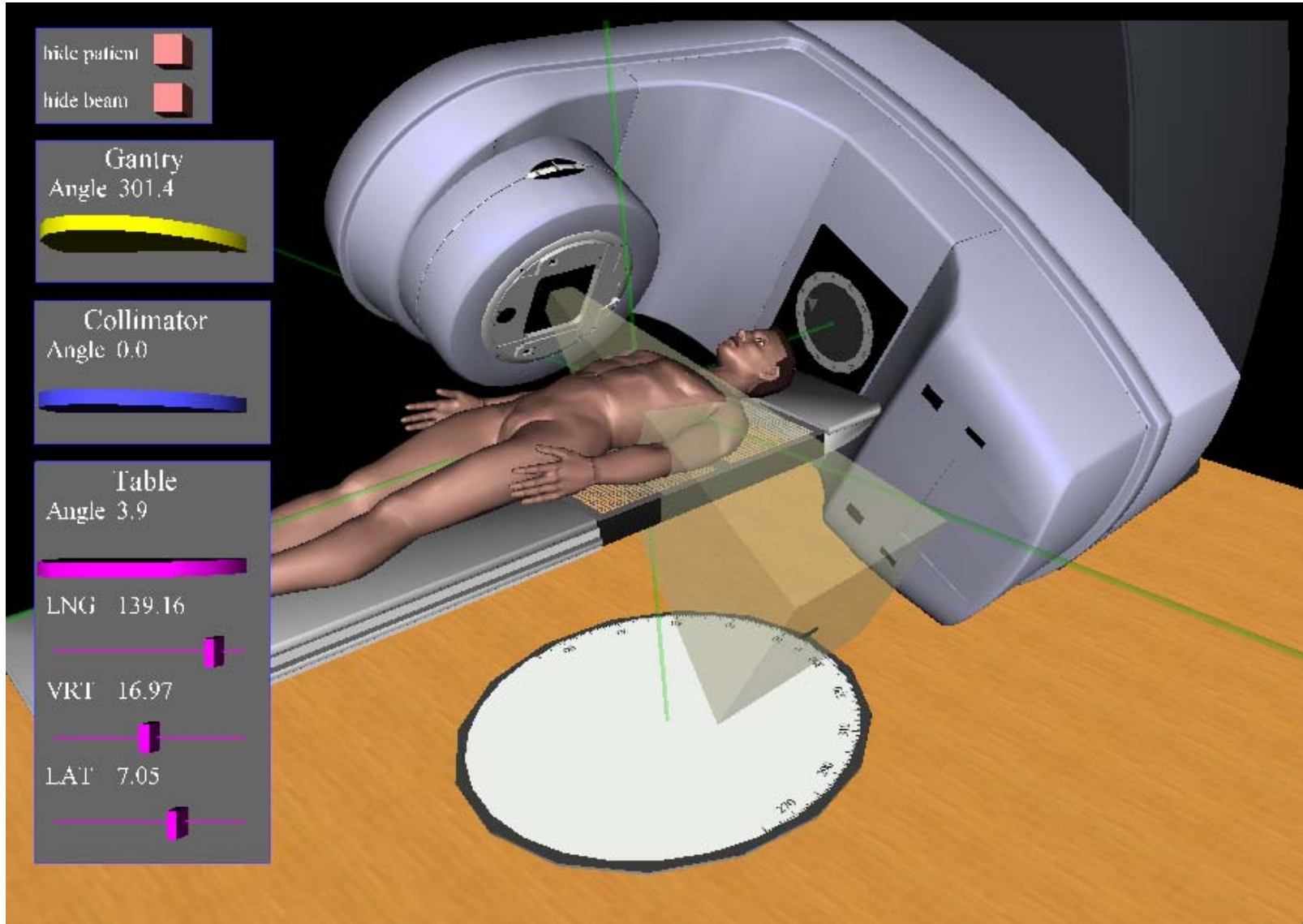
- Most of the currently available treatment planning systems offer little or no information for the treatment planner on possible collision scenarios during the planning process
- Most collision scenarios are found by RTTs during visual treatment verification checks
- Computer Controlled Radiation Therapy (CCRT) requires precise knowledge of the relative positions of all linac components with respect to the patient and to each other.

# Am dori sa avem capabilitatea de:

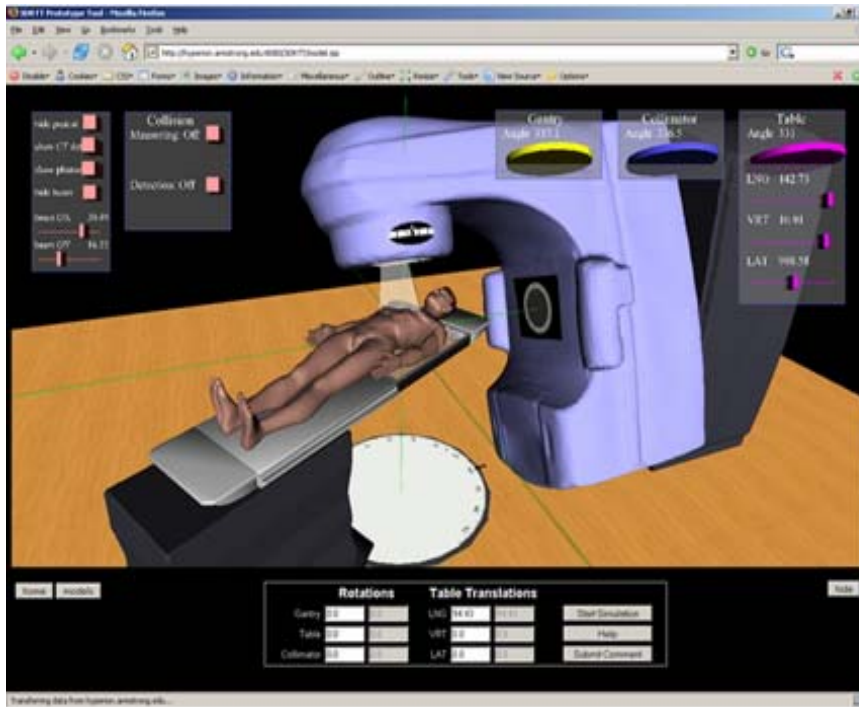
1. Generarea unei simulari 3D realiste a camerei de tratament si a echipamentului la rezolutie cit mai mare
2. Sa putem testa diferite pozitii ale echipamentului gantry, table, collimator, in mod cit mai realistic fara riscul de a distruge componente.
3. Sa vizualizam traiectoria razei, a laserului de pozitionare si a pacientul pe masa de operatie impreuna cu echipamentele aditionale de imobilizare.

# 3DRTT Simulator

- 3D Radiation Therapy Treatment: Varian Trilogy 23ix

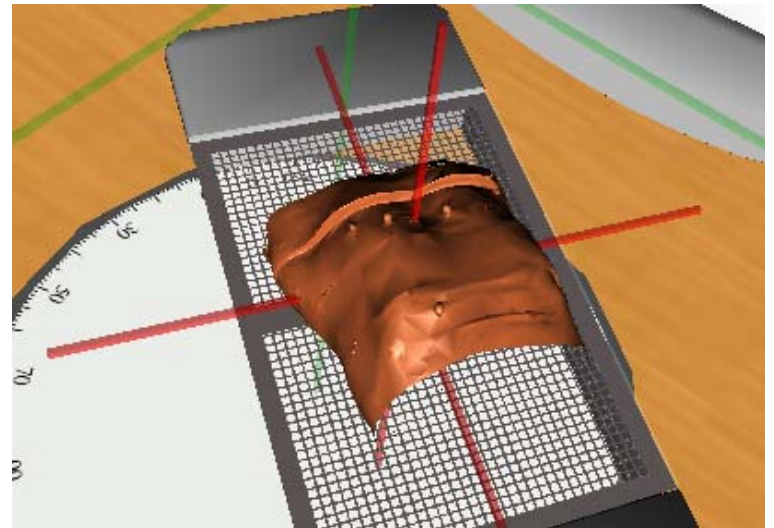


# Varian Trilogy™ & Novalis™ (BrainLab™)



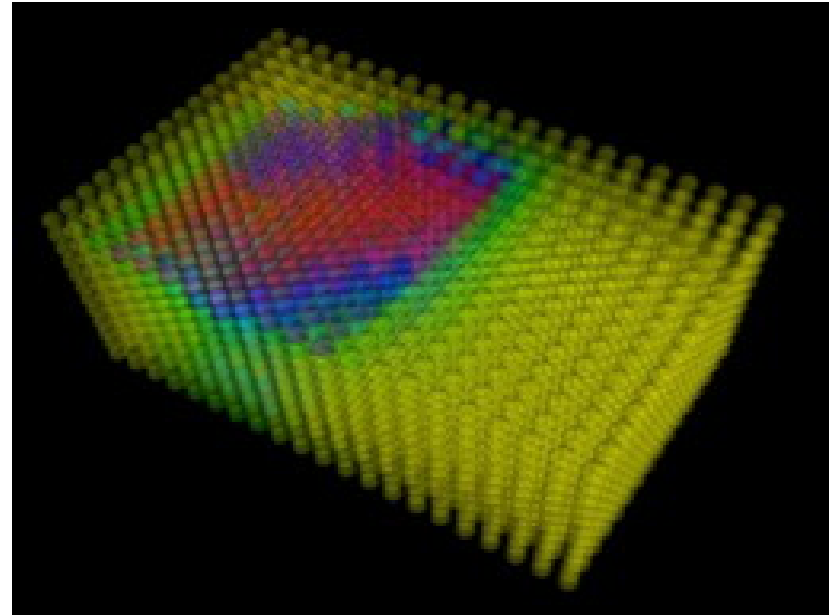
# Patient specific data

- Patient specific CT data in the simulator



## 2. 3DRDV (3D Radiation Dosage Visualization)

- Generarea harti 3D de radiatie in volum pt. verificarea dozelor
- Folosind DICOM-RT



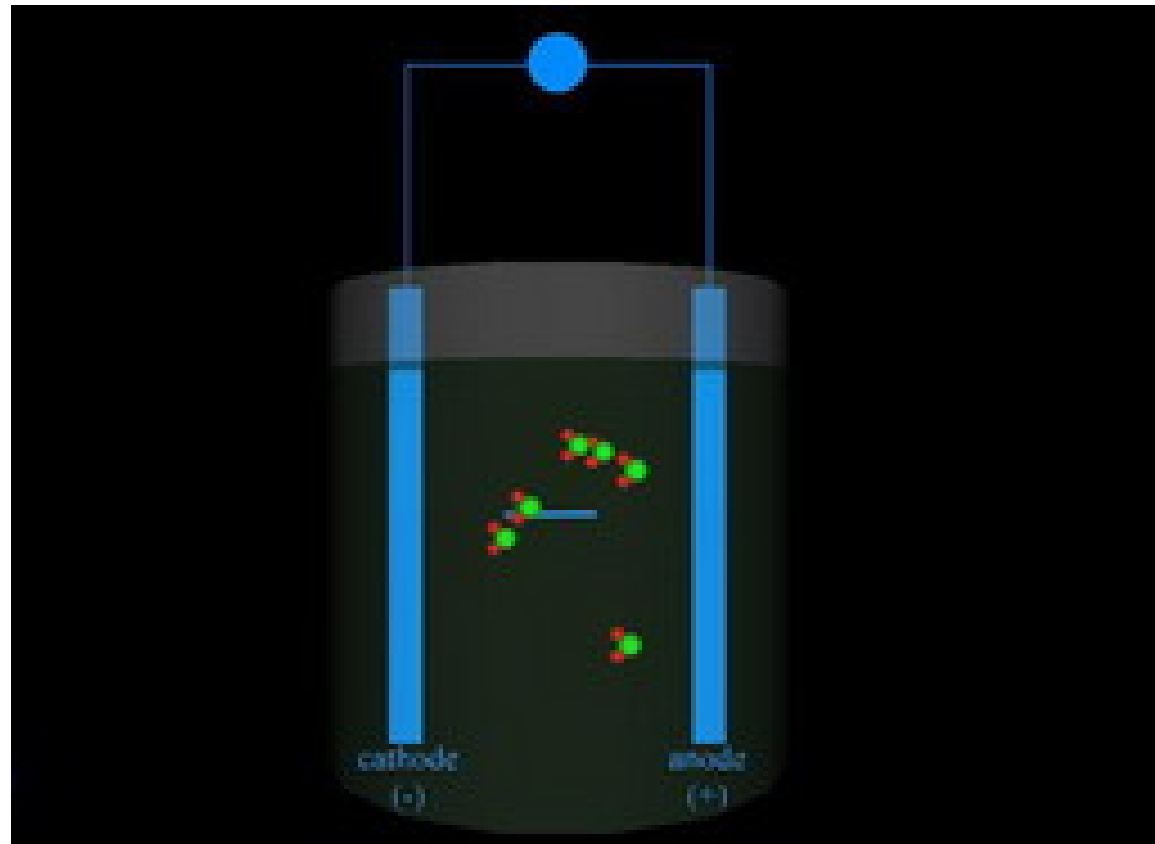
# 3. Neuro Pathways (e-Learning Sistemul Nervos)

- Colaborare cu Mercer Medical School
- Neural Network Simulator for impulse propagation

Short demo

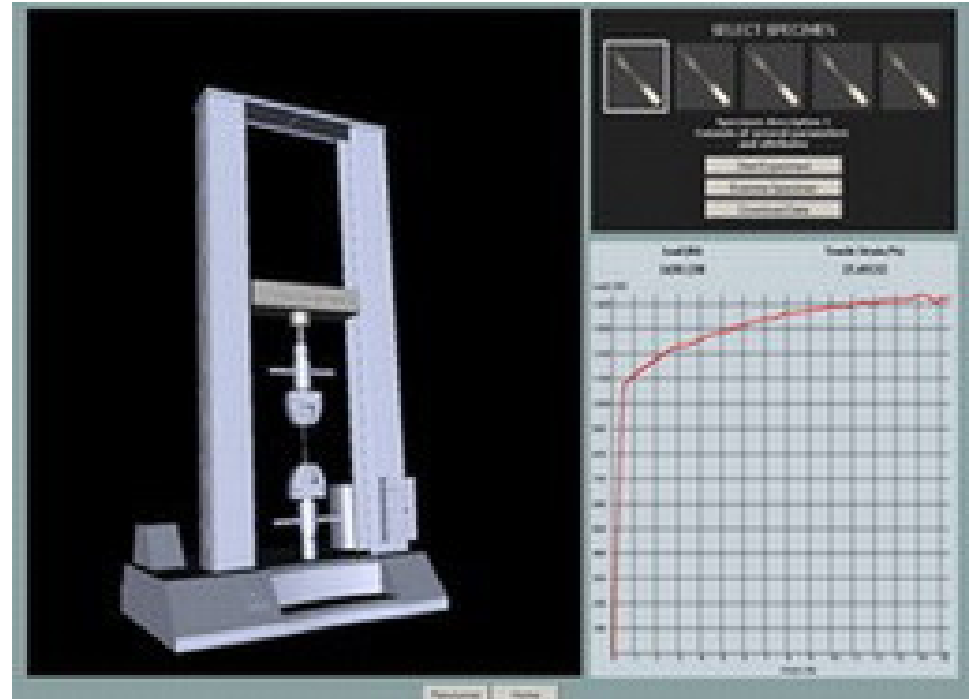
## 4. Simulare fenomene si procese (e.g. electroliza)

- Demo

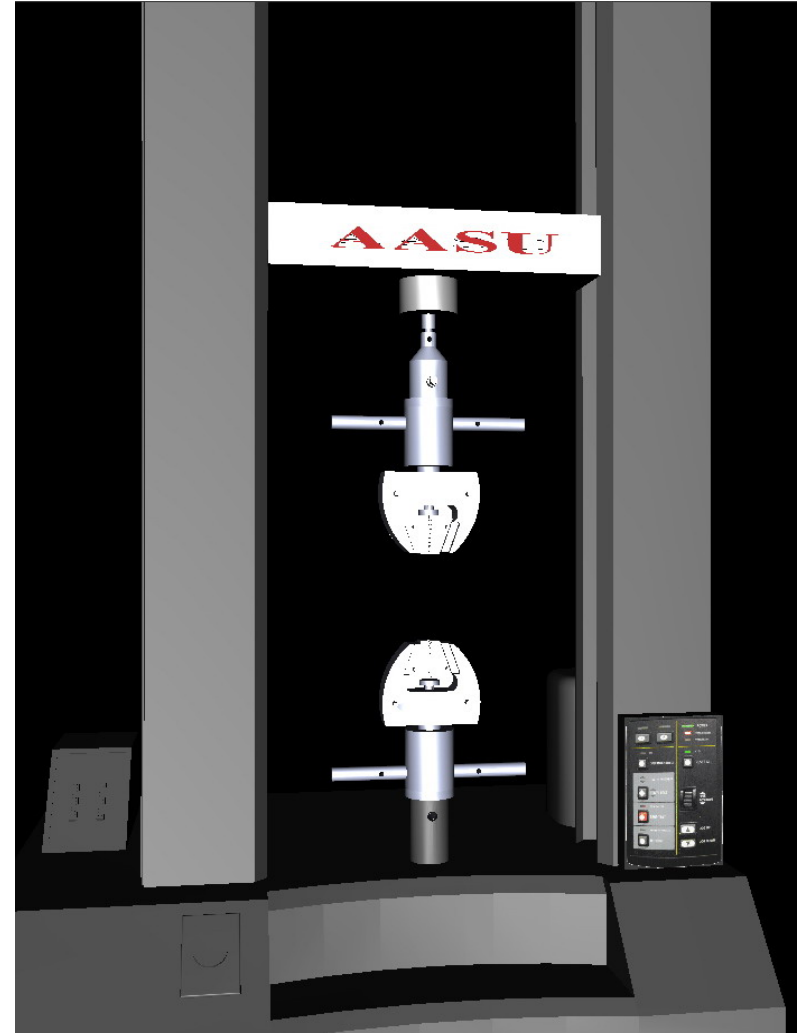
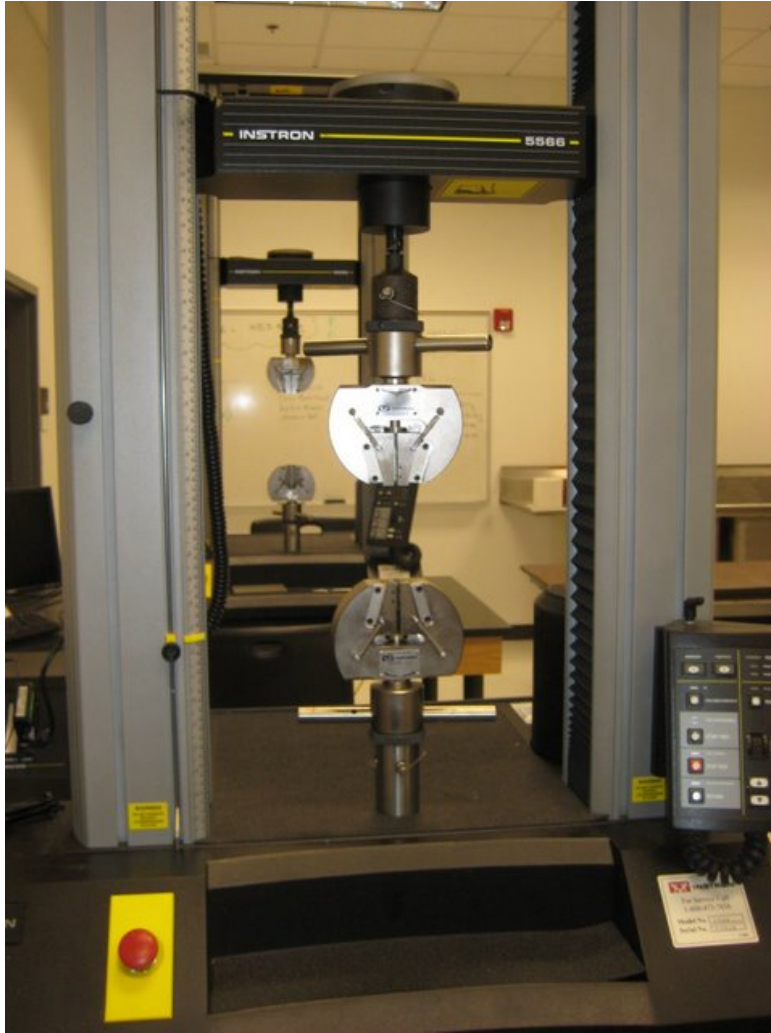


# 5. Ingineria Materialelor

- VIEW (Virtual Interactive Engineering on the Web)



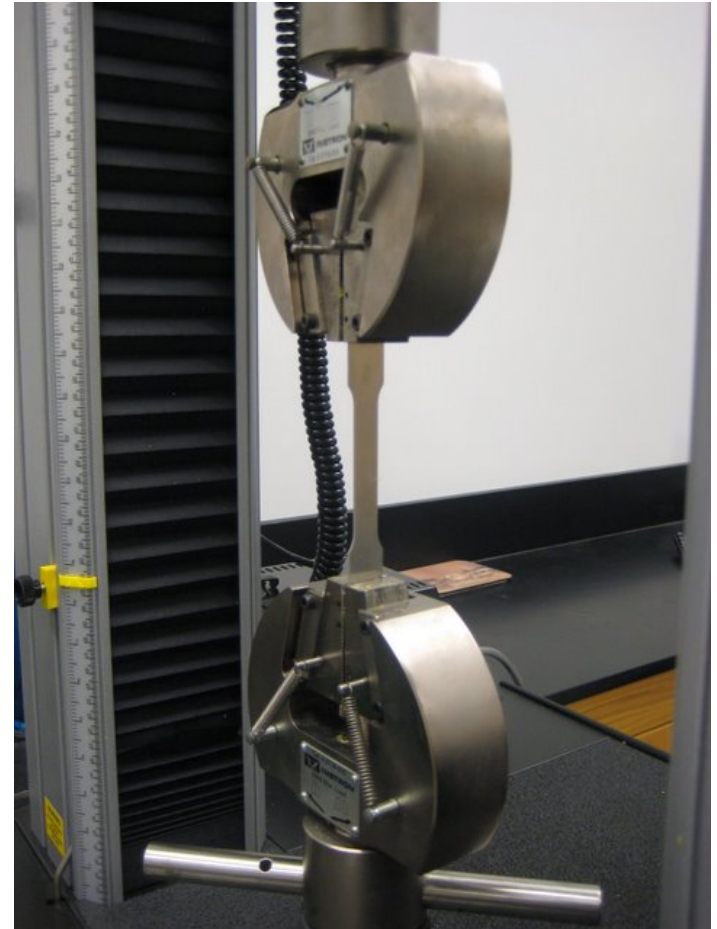
# Tensile Testing Experiment



**Figure 1:** *Instron<sup>TM</sup> 5566 real TTM (left) and simulator (right)*

# Tensile Testing Experiment

- Objective – introduce basic testing techniques required to evaluate mechanical properties of materials (hardness, ductility, and stiffness)
- Setup involves a Tensile Testing Machine (TTM); our Virtual TTL (VTTL) models an Instron™ 5566 TTM (figure 1).
- Sample of a certain material is mounted into the holding grips of the TTM, and the upper grip pulls the sample upward (figure 2).



**Figure 2:** *Sample fixation in the grips of TTM*

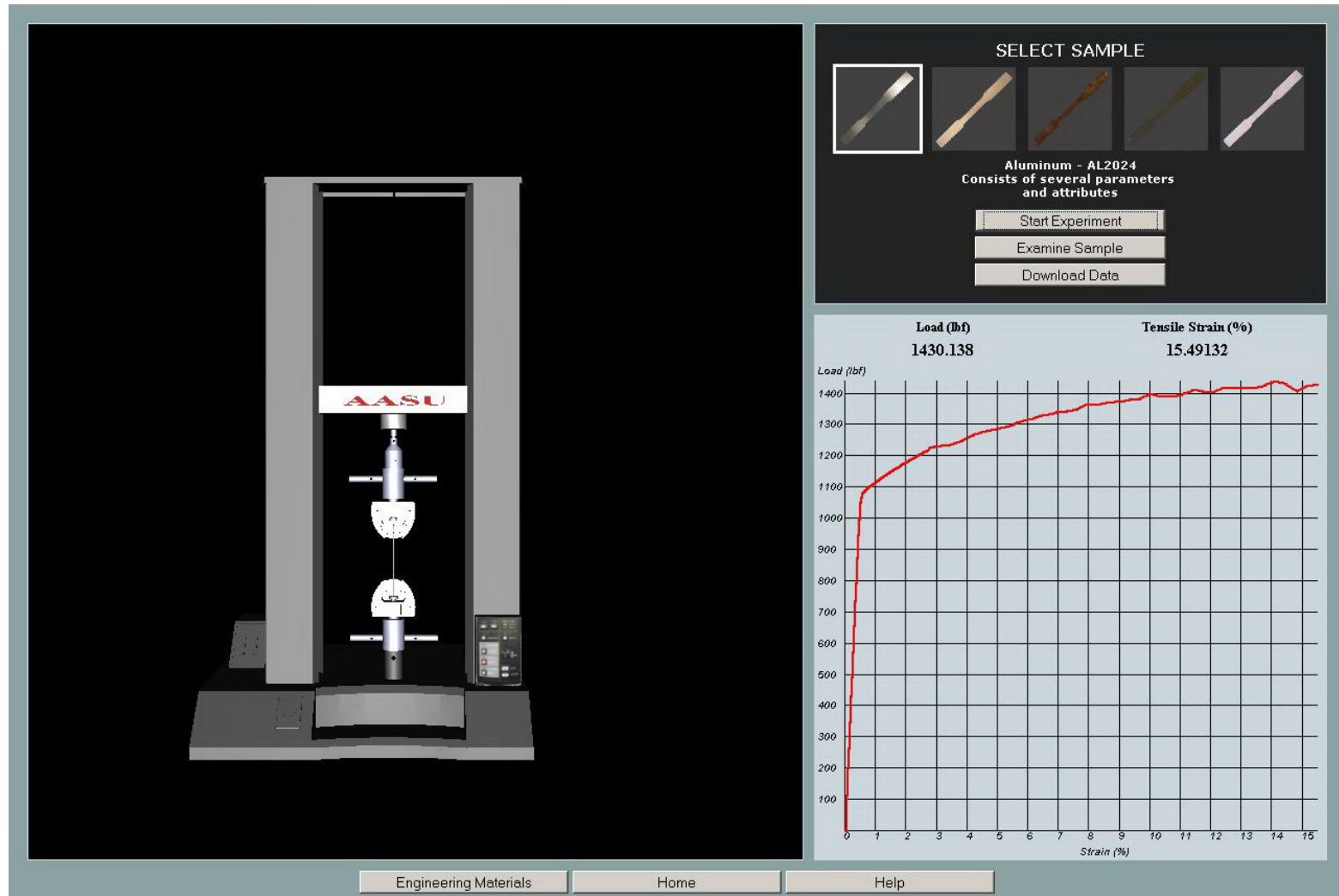
# Tensile Testing Experiment

- TTM controller measures load and strain and transmits the information to the computer.
- A load-strain linear graph with the results is obtained.
- These data can be used for further analyses with MATLAB™ and other software.

# Simulator Implementation

- Three key components:
  - PHP
  - X3D
  - JavaScript
- X3D is an ISO standard - real-time graphics processing.
- JavaScript provides the interaction between the elements of the graphical user interface (GUI).
- Additional components:
  - ECMAScript
  - AJAX (Asynchronous JavaScript and XML)

# Graphical User Interface



**Figure 3: VTTL's GUI**

# 6. Robotica si Control la Distantza

- BACH (Broadband Analysis of Collaborative Haptics)

Senzatia Tactila  $\Leftrightarrow$  Haptic  $\Leftrightarrow$  Force Feedback

# Haptics

- **Greek word “*haptikos*”**  
**(“capabilitatea de a atinge”)**
- **Cele 5:** vedere, miros, gust, **tactil**, and auz
- **Haptic interfaces**

# Haptics

# Haptic Devices



Phantom  
Omni




Phantom  
Desktop




Falcon™ Novint

*Courtesy of SensAble Technologies*

# Principiu de operare



physical  
reference  
point



visual  
reference  
point

- Bratz robotic care urmareste pozitia si orientarea mainii utilizatorului
- Pozitia si orientarea e re-citita la fiecare millisecunda (1 KHz)
- Reprezentarea vizuala a unui punct de referinta in mediul virtual. (vezi sfera galbena din stinga)

# Haptic Applications

- Medical
  - **Virtual Reality Simulation Training (refine and practice skills)**
  - **Telementoring**
  - **Patient Rehabilitation (Motor skills after stroke)**
- Entertainment
  - **On-line Haptic Gaming (! *Growing FAST*)**
- Hazardous Environments
  - **Remote controlled robotic vehicles (e.g. recovery operations)**
- Academic Research
- **Education (HaptEK16)**

# Video Games & Haptics

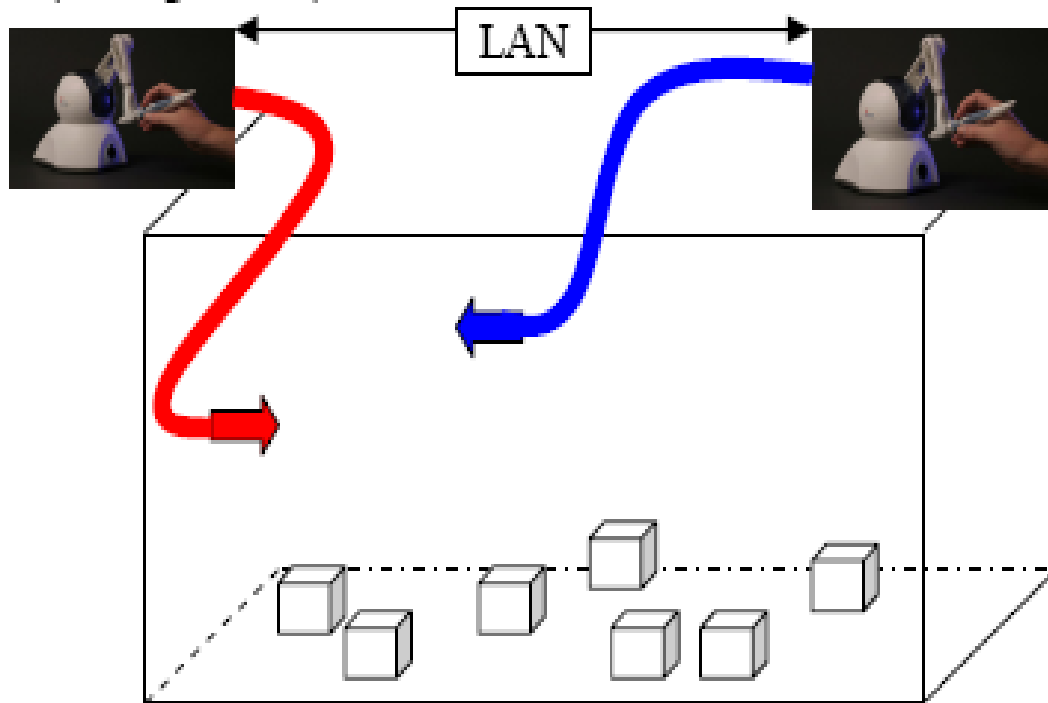


# Internet –Aplicatii distribuite pt. control la distanta

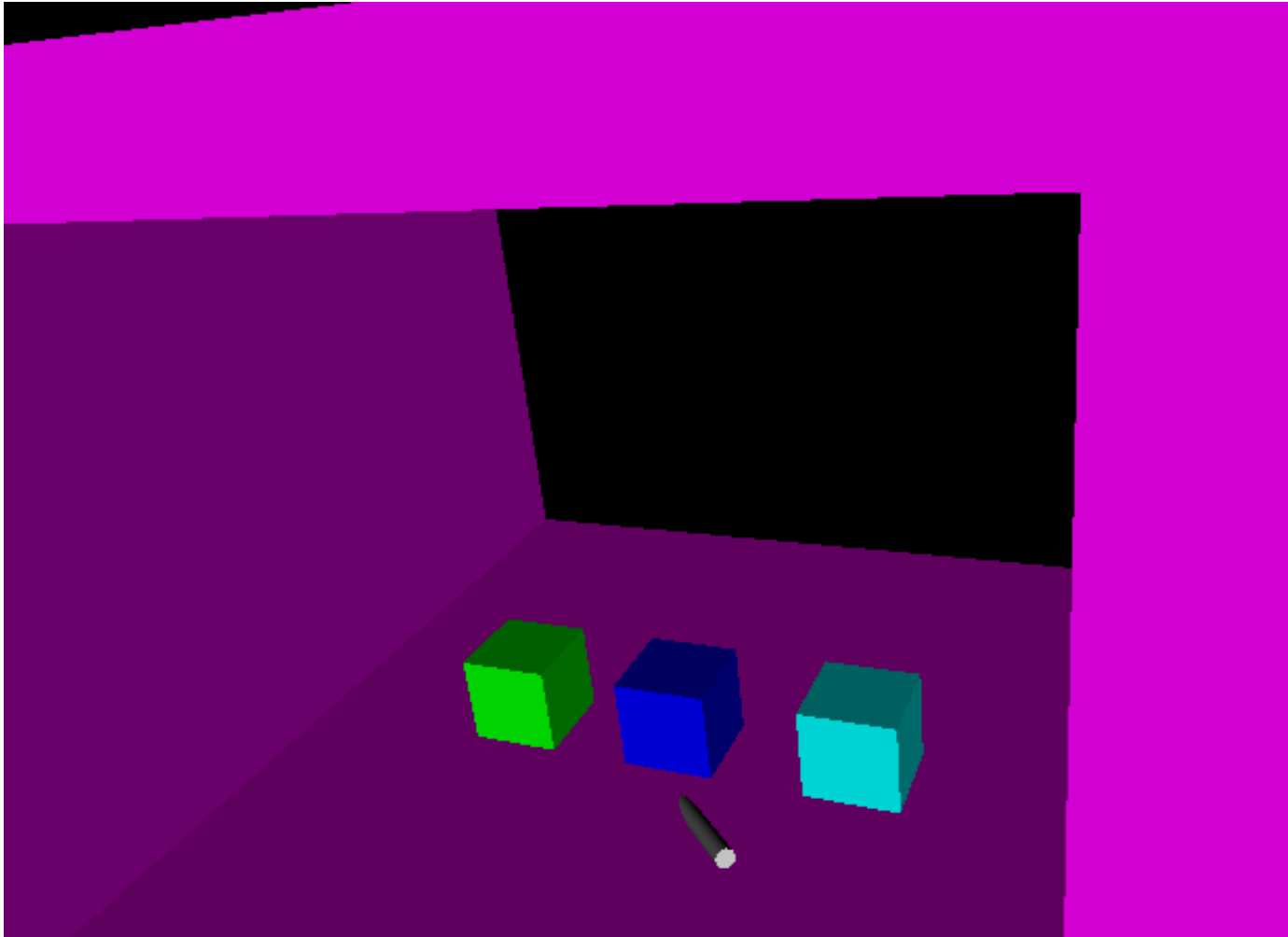
- Extinde force feedback la aplicatii distributed pe Internet
- Participanti multipli
- Teaching by example, ghidarea mainii de la distanta (mana in mana) – pt. aplicatii medicale



# Experiment Collaborativ Haptic



# Scena




Demo (film)

# Multzumesc

- Felix G. Hamza-Lup

[www.cs.armstrong.edu/felix](http://www.cs.armstrong.edu/felix)

sau

 “Felix Hamza”