

Scientific Data Visualization

Vizualizarea Stiintifica a Datelor


Vizualizarea datelor stiintifice

Modelare, Simulare, Vizualizare

Ziua	Ora	Sala	Sapt.	Tip	Form.
Miercuri	16~18	L320	*	C	<u>1 C.I.Per.~Engl.</u>
	18~20	L321	S2	Sem.	

http://www.cs.ubbcluj.ro/~per/Web_Page/Cursuri.htm

○ http://www.cs.ubbcluj.ro/~per/Scs_Per/Sdv/Sdv.html



Universitatea Babeş-Bolyai, Cluj-Napoca

Facultatea de Matematică și Informatică

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Cursuri 2016-2017

Semestrul I	<p style="text-align: center;"><i>Per</i></p> <p>03.10 - 23.12</p> <p>* 30.11.2016</p> <p>* 01.12.2016</p> <p>26.12 - 08.01</p> <p>09.01 - 22.01</p> <p>23.01 - 12.02</p> <p>13.02 - 19.02</p> <p>20.02 - 26.02</p>	<p style="text-align: center;"><i>Act.</i></p> <p>Act. Did.</p> <p>Sfântul Andrei</p> <p>Ziua Națională</p> <p>Vacanță</p> <p>Act. Did.</p> <p>Sesiune</p> <p>Vacanță</p> <p>Restanțe</p>	<p style="text-align: center;"><i>Dur.</i></p> <p>12 Săpt.*</p> <p>Liber</p> <p>Liber</p> <p>2 Săpt.</p> <p>2 Săpt.</p> <p>3 Săpt.</p> <p>1 Săpt.</p> <p>1 Săpt.</p>	<p><u>Grafică pe Calculator</u></p> <p><u>Decision Support Systems</u></p> <p>Info-Didactic: <u>Tehnologia informației (pentru perfecționarea profesorilor)</u></p> <p>Util.Soft.Spec. (<u>EFS-SPM, IFR</u>)</p> <p><u>Proiect Colectiv</u></p> <p><u>Fundamentele Programării</u></p> <p><u>Fundamentele Programării (Sem., Lab.)</u></p> <p><u>Proiect Individual</u></p> <p><u>Progr. Calc.</u></p>																																												
Semestrul II	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sapt.</th> <th style="text-align: center;">S</th> <th style="text-align: center;">NeTer.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">27.02 ~ 16.04</td> <td style="text-align: center;">S1-S7</td> <td style="text-align: center;">Act. Did.</td> </tr> <tr> <td style="text-align: center;">17.04 ~ 23.04</td> <td style="text-align: center;">V1</td> <td style="text-align: center;">Vacanta</td> </tr> <tr> <td style="text-align: center;">24.04 ~ 11.06</td> <td style="text-align: center;">S8-S14</td> <td style="text-align: center;">Act. Did.</td> </tr> <tr> <td style="text-align: center;">12.06 ~ 2.07</td> <td style="text-align: center;">E1-E3</td> <td style="text-align: center;">Ses. Ex.</td> </tr> <tr> <td style="text-align: center;">03.07 ~ 9.07</td> <td style="text-align: center;">V2</td> <td style="text-align: center;">Vacanta</td> </tr> <tr> <td style="text-align: center;">10.07 ~ 16.07</td> <td style="text-align: center;">R</td> <td style="text-align: center;">Restanta</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sapt.</th> <th style="text-align: center;">S</th> <th style="text-align: center;">Term.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">27.02 ~ 16.04</td> <td style="text-align: center;">S1-S7</td> <td style="text-align: center;">Act. Did.</td> </tr> <tr> <td style="text-align: center;">17.04 ~ 23.04</td> <td style="text-align: center;">V1</td> <td style="text-align: center;">Vacanta</td> </tr> <tr> <td style="text-align: center;">24.04 ~ 28.05</td> <td style="text-align: center;">S8-S12</td> <td style="text-align: center;">Act. Did.</td> </tr> <tr> <td style="text-align: center;">29.05 ~ 11.06</td> <td style="text-align: center;">E1-E2</td> <td style="text-align: center;">Ses. Ex.</td> </tr> <tr> <td style="text-align: center;">20.06 ~ 2.07</td> <td style="text-align: center;">P1-P2</td> <td style="text-align: center;">Preg. Ld</td> </tr> <tr> <td style="text-align: center;">03.07 ~ 9.07</td> <td style="text-align: center;">Ld1</td> <td style="text-align: center;">Ex. Ld</td> </tr> <tr> <td style="text-align: center;">1.05 & 5.06</td> <td></td> <td style="text-align: center;">Liber</td> </tr> </tbody> </table>	Sapt.	S	NeTer.	27.02 ~ 16.04	S1-S7	Act. Did.	17.04 ~ 23.04	V1	Vacanta	24.04 ~ 11.06	S8-S14	Act. Did.	12.06 ~ 2.07	E1-E3	Ses. Ex.	03.07 ~ 9.07	V2	Vacanta	10.07 ~ 16.07	R	Restanta	Sapt.	S	Term.	27.02 ~ 16.04	S1-S7	Act. Did.	17.04 ~ 23.04	V1	Vacanta	24.04 ~ 28.05	S8-S12	Act. Did.	29.05 ~ 11.06	E1-E2	Ses. Ex.	20.06 ~ 2.07	P1-P2	Preg. Ld	03.07 ~ 9.07	Ld1	Ex. Ld	1.05 & 5.06		Liber		<p><u>Prelucrarea Imaginilor (Cr Re Im)</u></p> <p><u>Scientific Data Visualization</u> <u>Mos</u></p> <p><u>Verificarea si validarea sistemelor soft</u></p> <p>Util.Soft.Spec. (<u>Kineto, IFR</u>)</p> <p><u>Proiect Colectiv</u></p> <p><u>Visualization and Validation in Simulation</u></p> <p><u>Structuri de Date și Algoritmi</u></p> <p><u>Proiect Individual</u></p> <p><u>Oop</u></p>
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Specializarea:

Calcul de înalta performanta și analiza volumelor mari de date

○ *Semestrul II*

Discipline oferite pentru curs opțional 1

Disciplina	Cadru didactic
<i>Vizualizarea datelor științifice</i>	<i>Lect. dr. Vasile Prejmerean</i>

• General data

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					36
Additional documentation (in libraries, on electronic platforms, field documentation)					36
Preparation for seminars/labs, homework, papers, portfolios and essays					36
Tutorship					18
Evaluations					18
Other activities: Project					14
3.7 Total individual study hours	158				
3.8 Total hours per semester	200				
3.9 Number of ECTS credits	7				

• Course objectives

To assimilate visualization and simulation techniques and the simulation as a method of studying the real phenomenon. To gain skills related to problem solving through simulation. To teach the students the concepts used in the field of modeling and simulation and to acquire the methods for validation of simulation.

After promotion the students should be able to use simulation as a method of solving real problems. They will know to verify their programs and to validate the simulation results.

Course contents

1. Simulation.
2. The Steps of a Simulation Study.
3. Verifying and validating a simulation model.
4. Techniques for validation.
5. Inspection. Testing.
6. Sensitivity analysis.
7. Calibration.
8. Input analysis.
9. Output analysis: output data analysis for simulations.
10. Statistical techniques needed for validation - data analysis and visualization
11. Visualization and simulation techniques
12. Interactive simulation and visualization

Bibliography

1. ARSHAM H., Systems Simulation: The Shortest Path from Learning to Applications, <http://www.ubmail.ubalt.edu/~harsham/simulation/sim.htm>
2. BALCI, O., Validation, Verification, and Testing Techniques through the Life Cycle of a Simulation Study, *Annals of Operations Research*, 1994, no.12, pp.1-49
3. BLAGA P., *Statistica prin MATLAB*, Presa Universitara Clujeana, 2002.
4. DODESCU Gh., *Simularea sistemelor*, Ed.Militara, Bucuresti.
5. M.Frențiu, *Verificarea corectitudinii programelor*, Ed.Univ."Petru-Maior", Tg.-Mureș, 2001, 116 pp., ISBN 973-8084-32-6
6. Averill M. Law and W. David Kelton, *Simulation Modeling and Analysis*, McGraw Hill, Third Edition (2000).
7. Kleijnen J.P.C., Theory and methodology of Verification and validation of simulation models, *European Journal of Operational Research*, 82(1995), 145-162.
8. STATE, L., J.POPESCU, *Modele probabiliste in Inteligenta Artificiala*, Litog. Univ. Bucuresti, 1979.
9. VADUVA I., *Modele de simulare cu calculatorul*, Ed. Tehnica, Bucuresti 1977.

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Additional references

- O1. Jack P.C. Kleijnen, Five-stage procedure for the evaluation of simulation models through statistical techniques, Proceedings of the 1996 Winter Simulation Conference, p.248-254.
- O2. Kleijnen J.P.C., Sensitivity analysis and optimization, Proceed. of the 1995 Winter Simulation Conference, p.133-140, 1995.
- O3. Kleijnen J.P.C., Validation of models: statistical techniques and data availability, Proceed. of the 1999 Winter Simulation Conference, 1999.
- O4. RACEANU, E., Limbaje de simulare, Ed.Militara, Bucuresti, 1981
- O5. SANDERSON D.P., R.SHARMA, R.ROZIN, and S.TREU, The Hierarchical Simulation Language HSL: A Versatile Tool for Process-Oriented Simulation, ACM Trans.on Modeling and Computer Simulation, Vol.1, no.2, 1991, pp.113-153.
- O6. T.I. Oren, Concepts and Criteria to Asses Acceptability of Simulation Study : a frame of reference, Comm.ACM, vol.24(1981), no.4, 180-184.
- O7. Papers on Software Metrics from the Journals:
 - a. IEEE Software.
 - b. IEEE Transactions on Software Engineering.
 - c. Transactions on Modeling and Simulation, ACM.
 - d. Software -- Practice and Experience, Wiley.

Assessment

A mark S is given for the activities at the seminars during the term. Then, a written examination must be given (mark W). The final grade is :

$$F = (W + S) / 2$$
 rounded according to the presences at the activities during the term.

Presence to the seminars is needed. The mark A reflects the activity of the student during the term and cannot be improved at exams.

$S \rightarrow (\text{Paper, Aplication} \sim \text{Project (Progr.+Doc.)}) = 2 * (P * 15\% + A * 35\%)$

$$F = (\text{Ref.} * 15\% + \text{Apl.} * 35\% + W * 50\%)$$

10. Evaluation			
Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic elements and concepts of the Scientific Data Visualization;	Written exam	50%
10.5 Seminar / Project	- complexity, importance and degree of timeliness of the synthesis made	Paper presentation	15%
	- apply the course concepts - problem solving	Project presentation	35%
10.6 Minimum performance standards			
➤ At least grade 5 at written exam, paper presentations and project realised.			

Homework (Examples)

- Railway Station & Transportation \rightarrow $T_{\text{impMediuAst.}}$, N_{rMedCal} (st)
- Warehouse & Customer \rightarrow C_{ost} (1 an)
- Traffic
- Epidemic
- ...

Examples in *Labor*

Resources and Links

We recommend the following resources and links:

- The INFORMS Web site : informs.org.
 - OR/MS Today : orms-today.com.
 - COIN-OR : coin-or.org.
 - COIN-OR : coin-or.org.
 - NEOS Server for Optimization : neos.mcs.anl.gov/neos/index.html.
 - H.Arsham's Modeling & Simulation Resources page: home.ubalt.edu/ntsbarsh/Business-stat/RefSim.htm.
 - Decision Science Resources page : home.ubalt.edu/ntsbarsh/Business-stat/Refop.htm.
 - Jay Aronson's DSS Software Web page: terry.uga.edu/people/jaronson/dss/DSS-Software.htm.
 - Decision Analysis Society : faculty.fuqua.duke.edu/daweb/dasw6.htm.
 - Interactive Linear Programming group: faqs.org/faqs/linear-programming-faq/.
-
- The Society for Modeling & Simulation International ~ JDMS: The Journal of Defense Modeling & Simulation ~ <http://www.scs.org/jdms>
 - Ali M. Niknejad, Analysis, Simulation, and Applications of Passive Devices on Conductive Substrates
 - Prof. Stephen G. Powell, Applications of Simulation ~ stephen.g.powell@dartmouth.edu, Tuck 210
 - EXPLORING MONTE CARLO SIMULATION APPLICATIONS FOR PROJECT MANAGEMENT, Young Hoon Kawak and Lisa Ingall, Department of Decision Sciences, School of Business, The George Washington University , Washington , DC , USA, IBM Systems Technology Group , Silver Spring , MD
 - Application of simulation techniques for accident management training in nuclear power plants, IAEA-TECDOC-1352, International Atomic Energy Agency, May 2003.

http://upm.ro/intranet/ecalin/cd_educational/cd/book/book.html

Capitolul 1- Introducere

O privire generala

Scopul cartii

Ideea principala

Structura cartii

Capitolul 2 - Problematika vizualizarii

Problematika generala

Cadrul stiintific

Problema specifica

Capitolul 3 - Vizualizarea stiintifica

Asupra terminologiei

Probleme actuale in vizualizarea stiintifica

Modelul de referinta in procesul de vizualizare stiintifica

Conditii fundamentale ale vizualizarii stiintifice

Modele pentru date

Exprimarea unor conditii suplimentare pentru functia de vizualizare

Nivelul vizualizare logica

Nivelul vizualizare fizica

Cu privire la ordonarea obiectelor geometrice virtuale

Relaxarea conditiilor procesului de vizualizare

Concluzi

Capitolul 4 - Modelarea datelor

Despre modelare

Reprezentarea datelor

Modelarea volumelor

Modelarea datelor distribuite neuniform

Modelarea prin triangulatie

Concluzii

Capitolul 5 - Tehnici de vizualizare a datelor experimentale

O taxonomie a tehnicilor de vizualizare a datelor experimentale

Maparea culorilor

Generarea de izocontururi si izosuprafete

Deformari geometrice

Vizualizarea datelor multidimensionale

Vizualizarea vectorilor

Reducerea seturilor de date

Vizualizarea datelor distribuite neuniform

Capitolul 6 - Tehnologii si sisteme de vizualizare

Sisteme de vizualizare

Tehnologia Java

Biblioteci pentru vizualizare

Vizualizari pe Web

Concluzii

Capitolul 7 - Construirea sistemelor de vizualizare cu VTK

VTK - O prezentare generala

Modelul grafic VTK

Obiecte VTK

Vizualizari cu VTK

Capitolul 8 - Aplicatii

Reconstructia 3D a reliefului

Vizualizarea zacamintelor pe baza datelor de foraj

Vizualizarea datelor experimentale sincrona si comparativa

Anexa A - Resurse privind vizualizarea stiintifica

Anexa B - Sisteme pentru vizualizare

Anexa C - Resurse VTK

Anexa D - Tcl/Tk

Glosar