

CES7AK - CES9AM MUSICAL INSTRUMENT MODELLING SIMULATION

CES7AL - CES9AL	ECTS Credits: 4	Semester: S7
Musical instrument Modelling and Simulation	Duration: 36 hours	
Person(s) in charge: Guillaume BONFANTE, Associate Professor, guillaume.bonfante@mines-nancy.univ-lorraine.fr , with Jean-Sébastien Kroll-Rabotin and Karim Ramdani.		
Keywords: C, High Performance computing, Modelisation of physical systems.		
Prerequisites: basic course in programming, python or C or Java.		
Objective: Student will be able to build a modelisation of a physical system at three levels, the physical analysis, the numerical analysis and the computer one		
Program and contents: Musical instruments are particularly interesting. Their numerical modelisation demand skills at three levels: physics, mathematics and computer science. First point, the physics of instruments is not at all trivial. Equations cover many aspects of physical models (1D issues, typically a string, 2D aspects, typically a drum head or 3Ds: a soundbox). Limit conditions are somewhat original. Second point, the mathematics involve equations of high degree and clearly more complex than what student usually find. Third, one needs to compute 44100 samples per second. This is clearly high given that one must compute the model of the instrument for each of them. We have the possibility to offer at Mines Nancy a course which covers the three domains. About mechanics, this is done by Jean-Sébastien Kroll-Rabotin, in mathematics, by Karim Ramdani and in computer science by Guillaume Bonfante Lesson 1 Course : The guitar, its strings and its soundboard (JSKR) Exercices : basics in C (GB) Lesson 2 Course : the air, limit conditions (JSKR) Exercices : arrays and loops in C (GB) Lesson 3 Course : domain of validity of models (JSKR) Exercices : pointers, memory management (GB) Lesson 4 Course : mathematical analysis for dummies (KR) Exercices : the string Lesson 5 Course : Theorem of Hille-Yosida, existence and unicity of solutions (KR) Exercices : making sounds Lesson 6 Course : numerical schemas, analysis and properties Exercices : the soundboard : building the net Lesson 7 Course : Solving the soundbox equations Exercices : the soundboard 2 : implentation of equations Lesson 8 Course : Stability issues Exercices : the soundboard 3 : limit conditions Lesson 9 Course : Limit conditions in 3D Exercices : third dimension 1 Lesson 10 Exercices : third dimension 2 Lesson 11 Course/Exercices : making sound out of the model Lesson 12 Evaluation : Student mark are synthesized from a continous evaluation during exercise sessions and by the sound quality of their final production.		
Evaluation:		

☐ Written test	☒ Continuous Control	☐ Oral report	☒ Project	☐ Written report
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