

A VIRTUAL TEST ASSESSMENT TOOL FOR SECOND YEAR SIGNAL PROCESSING STUDENTS

E. Palmer

School of Engineering Systems
Queensland University of
Technology
Brisbane, Australia

R.A. Wiltshire

CEA Technologies
Canberra, Australia

V. Chandran

School of Engineering Systems
Queensland University of
Technology
Brisbane, Australia

ABSTRACT

The development and use of a virtual assessment tool for a signal processing unit is described. It allows students to take a test from anywhere using a web browser to connect to the university server that hosts the test. While student responses are of the multiple choice type, they have to work out problems to arrive at the answer to be entered. CGI programming is used to verify student identification information and record their scores as well as provide immediate feedback after the test is complete. The tool has been used at QUT for the past 3 years and student feedback is discussed. The virtual assessment tool is an efficient alternative to marking written assignment reports that can often take more hours than actual lecture hall contact from a lecturer or tutor. It is especially attractive for very large classes that are now the norm at many universities in the first two years.

Index Terms— On-line assessment, signal processing education

1. INTRODUCTION

The increase in student numbers experienced across the world has put extra strain on university departments [1]. They have to cope with large classes that demand increased man-hours for assessment. For example, at 10 minutes per student for an assignment it takes 40 hours to mark 2 assignments from 120 students. This is in excess of the number of formal contact lecture hours (3 hours a week for 13 weeks) for a typical unit or subject in a semester.

Many schools have introduced web based learning tools. These may take the form of simple repositories ranging from lecture notes to multi-media learning tools. Alternatively they can be interactive in nature based on Java applets, [2] or virtual laboratories as have been implemented at Case-Western University, [3] and the University of

Virginia, [4]. Some have also developed virtual assessment tools.

Virtual assessment can provide an attractive alternative to standard assignments and examinations. This paper describes an initiative developed at the Queensland University of Technology, Brisbane, Australia directed at the on-line assessment of second year classical signal processing students as an alternative to a standard assignment or invigilated exam.

2. BACKGROUND

Classical signal processing is a subject taught in second semester of the second year of electrical engineering undergraduates at the Queensland University of Technology. The subject covers the following topics:

- Fourier Series
- Fourier Transforms
- Linear Systems & Laplace Transforms
- Transfer Functions
- Analog filter design
- Sampling and Quantization
- Z-transforms

The class size is typically of the order of over 200 students. Until 2003 an assignment or mid-semester test was used to provide summative and formative assessment for students... These forms of assessment typically required approximately 100 hours of marking. In order to make the assessment process more efficient a virtual test was implemented in 2003. The 2003 test was written in Java and was found to be prone to problems, particularly of academic dishonesty.

Academic dishonesty in on-line assessment has been an issue noted by a number of workers, [5]. This can take the form of

- Attempting to access the test multiple times

- Attempting to access the test outside of prescribed hours
- Taking the test by proxy

In order to discourage this in 2004 a new test was designed based on CGI (Common Gateway Interface) scripts

3. CGI BASED VIRTUAL TEST

When accessing the test site the student is presented with a detailed explanation of what is entailed in the taking the test, see Figure 1 below. Shown in Figure 1 is the initial page for the virtual test given in 2004. In later versions a checkbox was added which had to be checked thereby signifying that the student has agreed to abide by the conditions laid out below. The actual test page that is generated once the “Start Test” button is pressed is shown in Figure 2.

The test page is organized into three frames. The top frame apart from giving the title of the test has a timer which shows how much time remains. The middle frame contains a series of links. Each link is to a question written as an html file which opens in a new window when the link is clicked on. Each question addresses a certain concept-skill set. In order to semi-randomize the questions, the actual question set an individual student receives is determined by their student identification number. For example, if say the second digit in a student’s identification number is a 7 then that student will get the 7th question in each of the 11 banks of questions. This rule can be changed at will by the instructor. By structuring the test in this way the questions may be easily modified or added to.

The bottom frame contains a series of drop-down boxes into which the student inputs his/her answer to each question. At the bottom of this frame there is a submit button which the student uses to submit his/her answers upon completing the test. Immediately the submit button is pressed the students score is displayed and feedback given on what concepts/skills need to be revised.

The score is recorded both in a class file containing the list of marks for the students who have completed the test and also in an individual file. The individual file contains the following data:

- the time the test was commenced
- how long the student took to complete the test
- the marks received
- the actual answers the student submitted allowing feedback to be given to students.

With a test instrument such as this that may be accessed from anywhere in the world even having it password protected, as indeed this site is, does not prevent the test

being conducted by proxy. One form of academic dishonesty that can be prevented is the multiple attempts at the questions and attempts to access the test outside of hours.

The former was a problem noted when the first Virtual Test was administered in 2003. In order to overcome this the software was written so that it was only accessible between prescribed hours on a particular date. As access to the site was by QUT student number and password, any attempt to access the questions outside of this time frame was easily detected and the identity of those making the attempt known. Similarly once the set of answers were submitted any further attempt to re-submit was blocked by the software and the identity of persons attempting this recorded.

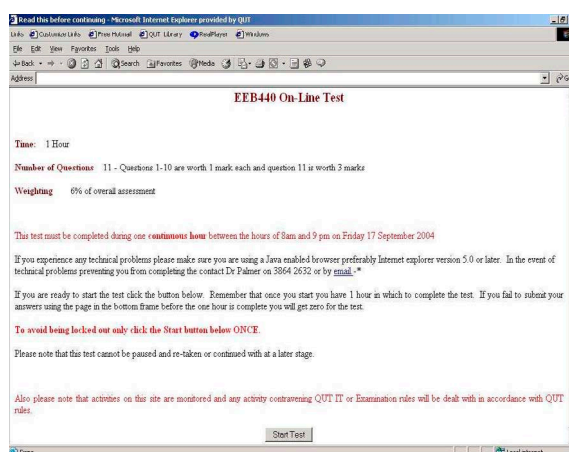


Figure 1 Virtual Test Initial Page

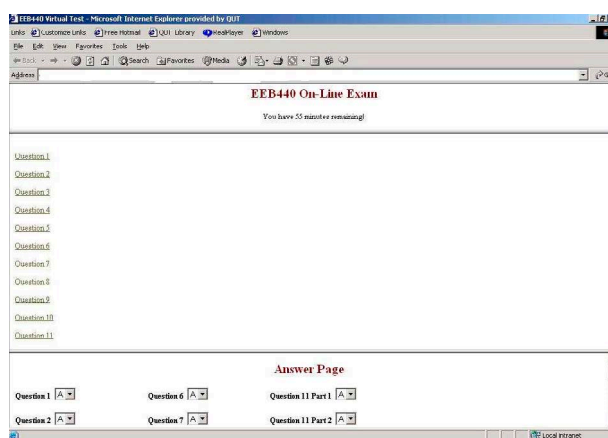


Figure 2 Test Page

4. STYLE OF QUESTIONS

While some work has been done using free form text input the style of questions chosen required multiple choice answers. Two virtual tests were written. The first virtual test covered the topics of

- Linear Systems
- Laplace Transforms
- Signal Classification
- Fourier Series
- Fourier Transforms
- Simulation diagrams
- Transient response of circuits
- Singularity functions
- Continuous time convolution

The second virtual test covered the topics of

- Realization of analog filters
- Frequency response of analog filters
- Design of analog filters
- Sampling and Quantization
- Difference equations and z-transforms
- Signal reconstruction

5. DISCUSSION

With regard to the virtual tests a survey was taken of 52 students who undertook the virtual tests in 2004 and 43 students who undertook the test in 2005. The questions posed and the responses are summarized by Tables 1 and 2. The survey shows the majority of students found that undertaking the tests assisted the learning process. Certainly students would have collaborated to some extent but this does not entirely destroy the integrity of the test instrument as the questions are semi-individualized. Indeed, some form of collaboration is expected and would have aided the learning process.

The survey shows that students are split on the issue of whether or not the level of feedback provided was satisfactory. This is one area which will be improved in future versions of the test, perhaps by providing virtual tutorials. It is shown by the survey results that the cohort is split on whether or not they prefer a virtual test over a standard assignment. One factor that may have been important in students not preferring the virtual test were a few technical problems that arose during its delivery. Such problems tended to mar the delivery of the test and it shows the need for strong support from Information Technology (IT) services in the university.

One thing borne out by the survey was the perception that the virtual tests were more prone to academic dishonesty. As has been mentioned measures to avoid the problem of

the tests being taken by proxy cannot be 100% effective unless the test is invigilated. With invigilation however, the benefits in flexibility are diminished. It is possible that this perception arises due to the fact that collaboration between students would have occurred. This is not seen as a problem however, as the questions were semi- as discussed earlier. As well, the weighting given to the tests in calculating the final mark for the unit was quite small; 15%. This means the benefits to the student in attempting to use unfair means to their advantage are greatly diminished. As [5] points out academic dishonesty is a serious issue in any form of on-line assessment.

Table 1: Survey of Students taking Virtual Tests in 2004 and 2005.

Question	% SA	% A	% N	% D	% SD
The Virtual Tests assisted the learning process	5.8 2.3	55.8 53.5	15.4 25.6	21.2 14.0	1.9 4.7
The level of feedback provided on my learning was satisfactory	7.7 0	36.5 48.8	21.2 14	28.8 27.9	5.8 9.3
I would have preferred the Virtual Test to taking an assignment	17.3 9.3	19.2 27.9	25.0 11.6	25.0 25.6	13.5 25.6
The Virtual Test is less prone to academic dishonesty and is a more reliable indicator of student learning than assignments.	1.9 4.7	11.5 18.6	11.5 25.6	46.2 25.6	28.8 25.6
I would like to see Virtual Tests more widespread across units in my course	1.9 7.0	23.1 27.9	23.1 18.6	30.8 32.6	21.2 14.0

SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree

The top figure in each cell refers to the 2004 cohort and the bottom figure refers to the 2005 cohort

The response of the students surveyed to the question of whether or not they would like the virtual test extended to other units was mixed. Only 25% of the cohort surveyed said that they would prefer these tests extended to other units. The reasons for this are unclear. The technical

problems experienced, the need to improve the quality of the feedback and a perceived susceptibility of the test to attempts at academic dishonesty are possible contributing factors

From the instructor's point of view the Virtual Tests provide an efficient way of assessing a large class, in both summative and formative modes. The enrolment for the unit in which the Virtual Tests have been used typically approaches 200. Two standard paper based assignments for such a class would generally involve a total of about 100 hours of marking. The issues of collaboration between students and the issue of students using proxies to do the work are still there with a traditional assignment. Added to this is the issue of plagiarism of other people's work. This can be overcome to some extent by individualizing assignments; however the marking of such assignments then becomes more complex. The advantage then to the instructor is that the assessments can be made and marking time and cost is reduced to zero. The issues of collaborative work being done by students and taking the tests by proxy are common to standard assignments as well and by giving the tests a smaller weighting on the overall assessment issues are somewhat mitigated.

Finally with regard to the style of questions asked on both the virtual tutorials and the virtual tests this has been restricted to multi-choice or numerical answers. Future work may look at allowing free form text input.

In summary the advantages of the virtual assessment tool described are:

1. flexibility
2. instant feedback for students
3. saving in terms of marking costs and time especially for large classes
4. the ability to re-try problems as many times as is necessary to effect mastery of the material, in the case of the virtual tutorials, and
5. encouragement of co-operative learning amongst students.

The disadvantages of the tool are:

1. a capacity for students to undertake the test or virtual tutorial by proxy
2. vulnerability to technical issues such as server problems
3. the amount of time needed to develop and refine such tools

the style of questions is restricted currently to numerical or multi-choice.

An on-line virtual test assessment tool developed for a signal processing subject at Queensland University of Technology is described. The virtual test was seen by students as improving their learning. It also allowed flexibility in time and location for those undertaking the test and helped provide as well as providing instant feedback to for students. Also there are net gains in marking costs which is seen as particularly beneficial for large classes.

7. REFERENCES

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6. CONCLUSIONS