ARCLG207
Remote Sensing in Archaeology

2013–2014

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# Contents

1 Overview 3  
1.1 Short description .............................................. 3  
1.2 Week-by-week summary ........................................... 3  
1.3 Basic texts .................................................. 3  
1.4 Methods of assessment .......................................... 4  
1.5 Teaching methods ............................................... 4  
1.6 Workload .................................................... 4  
1.7 Prerequisites ................................................ 4  

2 Aims, objectives and assessment 4  
2.1 Aims .......................................................... 4  
2.2 Objectives ................................................... 5  
2.3 Learning outcomes .............................................. 5  
2.4 Coursework .................................................. 5  
2.5 UCL-wide penalties for late submission of coursework .............. 7  
2.6 Timescale for return of marked coursework to students ................. 8  
2.7 Keeping copies ............................................... 8  
2.8 Citing of sources .............................................. 8  
2.9 Avoiding Plagiarism ............................................ 8  

3 Schedule and syllabus 9  
3.1 Teaching schedule ............................................. 9  
3.2 Detailed week-by-week syllabus ................................ 9  

4 Online resources 14  

5 Additional information 14  

6 How to upload your work to Turnitin 15  

This document and other resources are available from the course website:  
http://moodle.ucl.ac.uk/course/view.php?id=7524
1 Overview

1.1 Short description

This course provides a working knowledge of the theory, method, equipment and software associated with remote sensing in archaeology, whether the latter is undertaken by ground-based, airborne or spaceborne methods. Students develop practical familiarity with GIS and remote sensing packages such as TerraSurveyor, ENVI and ArcGIS, various raster-based image formats, and a variety of equipment for field capture of remote sensing data.

The structure of the course provides students with opportunities for both field- and lab-based learning and is taught using a combination of lectures, practical lab sessions and tutorials in the Institute’s AGIS laboratory, as well as a short fieldwork component. It is assessed via a notebook of analytical work and one essay. It would benefit both those who thereafter wish to use remote sensing approaches in a commercial environment and those looking to design future research projects with these methods in mind.

1.2 Week-by-week summary

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Session</th>
<th>Subject</th>
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<tbody>
<tr>
<td>1</td>
<td>13th January 2014</td>
<td>1</td>
<td>Introduction to Remote Sensing Techniques</td>
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<tr>
<td>2</td>
<td>20th January 2014</td>
<td>2</td>
<td>Digital Mapping. Total station, GPS, DGPS</td>
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<td>3</td>
<td>27th January 2014</td>
<td>3</td>
<td>Geophysics I. Principles and Primary Methods</td>
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<td>4</td>
<td>3rd February 2014</td>
<td>4</td>
<td>Geophysics II. Secondary Processing and Interpretation</td>
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<td>5</td>
<td>10th February 2014</td>
<td>5</td>
<td>Integrating Digital Maps and Geophysics Data</td>
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<td>6</td>
<td>17–18th February 2014</td>
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<td>Reading week Practical course at Headstone Manor</td>
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<tr>
<td>7</td>
<td>24th February 2014</td>
<td>6</td>
<td>Introduction to Aerial and Satellite-borne imagery</td>
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<td>8</td>
<td>3rd March 2014</td>
<td>7</td>
<td>High-resolution and multi-spectral imagery. Basic methods</td>
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<td>9</td>
<td>10th March 2014</td>
<td>8</td>
<td>Multi-spectral imagery. Advanced methods</td>
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<td>10</td>
<td>17th March 2014</td>
<td>9</td>
<td>SAR, LIDAR, SAR and hyperspectral imaging</td>
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<td>11</td>
<td>24th March 2014</td>
<td>10</td>
<td>Computer vision. Object and landscape models</td>
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1.3 Basic texts

The key texts for this course are:

Bettess, F. 1998 *Surveying for Archaeologists.* (3rd ed.), Durham: Dept. of Archaeology. INST ARCH AL 12 BET

Conyers, L. B. 2004 *Ground-penetrating Radar for Archaeology*, Oxford: AltaMira Press. INST ARCH AL 12 CON

Gaffney, C. F. et al 2002 *The Use of Geophysical Techniques in Archaeological Evaluations*, Reading: IFA. Issue desk INST ARCH GAF; INST ARCH AL QTO. GAF


1.4 Methods of assessment

This course is assessed by means of a total of 5000 words of coursework, divided into a portfolio of practical work of about 2000 words in total (50%) and one 3000 word essay (50%). The topics and deadlines for each assessment are specified below. If students are unclear about the nature of an assignment, they should contact the Course Co-ordinator. The Course Co-ordinator will be willing to discuss an outline of their approach to the assessment, provided this is planned suitably in advance of the submission date.

1.5 Teaching methods

Teaching will be by a mixture of lectures, seminars, demonstration and supervised practical exercises. Lectures and seminars will last for two hours, or one hour when followed by a practical class. Practical classes will normally involve direct supervision for one hour, often followed by a further hour during which time the tutor will be available to help as you work through exercises on your own.

N.B. Participation in practical exercises is limited by the availability of suitably equipped computers, and is guaranteed only for those who are taking this course as an examined module for a Masters degree.

The course also includes a two-day field course held in reading week.

1.6 Workload

There will be 15 hours of seminars/lectures for this course and 15 hours of supervised practicals, as well as 15 hours on the field course. You will be expected to undertake around 75 hours of reading and independent project work for the course, plus 30 hours producing the assessed work. This adds up to a total workload of 150 hours for the course.

1.7 Prerequisites

There are no formal prerequisites for this course, but it is strongly recommended that students have at least some prior experience of GIS.

2 Aims, objectives and assessment

2.1 Aims

The course aims to provide:

- An advanced knowledge of remote sensing techniques
- Practical experience of geophysics and survey equipment
- The statistical and theoretical concepts behind image-based processing and classification
2.2 Objectives

The course objectives are that you will be able to:

• Evaluate the strengths and weaknesses of different remote sensing methods or platforms
• Design and implement reliable ground-based remote sensing projects
• Integrate ground-based methods with air photos and satellite imagery
• Manipulate remote sensing imagery in ways that go well beyond simple inspection of the results by eye

2.3 Learning outcomes

In meeting these objectives you will also be able to demonstrate the following learning outcomes:

• Detailed knowledge of remote sensing techniques
• Ability to evaluate critically published examples of these applications
• Familiarity with the range of remote sensing software

2.4 Coursework

Assessment tasks

This course is assessed entirely by coursework consisting of the two assignments described here.

1. One 2,850–3,150 word essay (50%) giving you an opportunity to demonstrate your theoretical understanding of an important issue in archaeological remote sensing. You should choose one of the following questions:

   • In recent years, geophysical survey has increasingly been used as the sole method for investigating an archaeological site rather than as an adjunct or prelude to excavation. What are the advantages and disadvantages of such an approach? Discuss with reference to one or more specific examples.

   • What one aspect of ground-based, airborne or satellite-based remote sensing do you think will have the most impact in archaeology over the next decade? Why is it so promising and what are the possible obstacles to it achieving its full potential?

   • ‘The manipulation of aerial and satellite imagery by archaeologists typically falls into one of two unsatisfactory camps, involving either (i) complicated classification routines that are hard to interpret or, more often, (ii) unstandardised, visual assessment of pixel patterns.’ Discuss this statement via two or more case studies.

2. One written account of laboratory and fieldwork work (50%), comprising a notebook in which you will record your answers to three exercises set during practical classes. This will provide an opportunity for you to demonstrate technical competence in a range of remote sensing methods. You will be provided with further information about the exact form that the notebook should take.

The submission deadlines are as follows:

(a) Essay: 28th March 2014;
(b) Notebook of lab work (deadlines to be announced fortnightly)

The notebook will require you to include illustrations, such as maps and graphs. Please ensure that these are carefully presented. General guidance is available at: http://www.ucl.ac.uk/archaeology/handbook/common/illustrations.htm. All illustrations should have informative captions. Where appropriate, maps should include indicators of scale and orientation, as well as a legend (key) based on sensible ranges of data values. Graphs should include informative labels for the X- and Y-axes.

Students are not permitted to re-write and re-submit essays in order to try to improve their marks. However, students may be permitted, in advance of the deadline for a given assignment, to submit for comment a brief outline of the assignment. The Course Co-ordinator is willing to discuss an outline of the student’s approach to the assignment, provided this is planned suitably in advance of the submission date.

Word-length

Strict new regulations with regard to word-length were introduced UCL-wide with effect from 2013:

3.1.7 Penalties for Over-length Coursework

For submitted coursework, where a maximum length has been specified, the following procedure will apply:

i The length of coursework will normally be specified in terms of a word count

ii Assessed work should not exceed the prescribed length.

iii For work that exceeds the specified maximum length by less than 10% the mark will be reduced by ten percentage marks; but the penalised mark will not be reduced below the pass mark, assuming the work merited a pass.

iv For work that exceeds the specified maximum length by 10% or more, a mark of zero will be recorded.

vii In the case of coursework that is submitted late and is also overlength, the lateness penalty will have precedence.

The word length for the essay for this course is 2,850-3,150. The portfolio should add up to 1,900–2,100 The following should not be included in the word-count: title page, contents pages, lists of figure and tables, abstract, preface, acknowledgements, bibliography, captions and contents of tables and figures, appendices, and wording of citations.

Submission procedures

Students are required to submit hard copy of all coursework to the course co-ordinators pigeon hole via the Red Essay Box at Reception by the appropriate deadline. The coursework must be stapled to a completed coversheet (available from the web, from outside Room 411A or from the library).

Students should put their Candidate Number on all coursework. This is a 5 digit alphanumeric code and can be found on Portico: it is different from the Student Number/ ID. Please also put the Candidate Number and course code on each page of the work.
It is also essential that students put their Candidate Number at the start of the title line on Turnitin, followed by the short title of the coursework, e.g., YBPR6 Funerary practices.

Please note the stringent UCL-wide penalties for late submission given below. Late submission will be penalized in accordance with these regulations unless permission has been granted and an Extension Request Form (ERF) completed.

Date-stamping will be via ‘Turnitin’ (see below), so in addition to submitting hard copy, students must also submit their work to Turnitin by the midnight on the day of the deadline. Students who encounter technical problems submitting their work to Turnitin should email the nature of the problem to ioa-turnitin@ucl.ac.uk in advance of the deadline in order that the Turnitin Advisers can notify the Course Co-ordinator that it may be appropriate to waive the late submission penalty. If there is any other unexpected crisis on the submission day, students should telephone or (preferably) e-mail the Course Co-ordinator, and follow this up with a completed ERF.

Please see the Coursework Guidelines on the IoA website (or your Degree Handbook) for further details of penalties. [http://www.ucl.ac.uk/archaeology/administration/students/handbook/submission](http://www.ucl.ac.uk/archaeology/administration/students/handbook/submission)

The Turnitin ‘Class ID’ is 611879 and the ‘Class Enrolment Password’ is IoA1314 Further information is given on the IoA website. [http://www.ucl.ac.uk/archaeology/administration/students/handbook/turnitin](http://www.ucl.ac.uk/archaeology/administration/students/handbook/turnitin) Turnitin advisers will be available to help you via email: ioa-turnitin@ucl.ac.uk if needed.

### 2.5 UCL-wide penalties for late submission of coursework

UCL regulation 3.1.6 Late Submission of Coursework

Where coursework is not submitted by a published deadline, the following penalties will apply:

i. A penalty of 5 percentage marks should be applied to coursework submitted on the calendar day after the deadline (calendar day 1).

ii. A penalty of 15 percentage marks should be applied to coursework submitted on calendar day 2 after the deadline through to calendar day 7.

iii. A mark of zero should be recorded for coursework submitted on calendar day 8 after the deadline through to the end of the second week of third term. Nevertheless, the assessment will be considered to be complete provided the coursework contains material than can be assessed.

iv. Coursework submitted after the end of the second week of third term will not be marked and the assessment will be incomplete.

vii. Where there are extenuating circumstances that have been recognised by the Board of Examiners or its representative, these penalties will not apply until the agreed extension period has been exceeded.

In the case of coursework that is submitted late and is also over length, only the lateness penalty will apply.
2.6 Timescale for return of marked coursework to students

You can expect to receive your marked work within four calendar weeks of the official submission deadline. If you do not receive your work within this period, or a written explanation from the marker, you should notify the IoA’s Academic Administrator, Judy Medrington.

2.7 Keeping copies

Please note that it is an Institute requirement that you retain a copy (this can be electronic) of all coursework submitted. When your marked essay is returned to you, you should return it to the marker within two weeks.

2.8 Citing of sources

Coursework should be expressed in a student’s own words giving the exact source of any ideas, information, diagrams etc. that are taken from the work of others. Any direct quotations from the work of others must be indicated as such by being placed between inverted commas. Plagiarism is regarded as a very serious irregularity which can carry very heavy penalties. It is your responsibility to read and abide by the requirements for presentation, referencing and avoidance of plagiarism to be found in the IoA 'Coursework Guidelines’ on the IoA website http://www.ucl.ac.uk/archaeology/administration/students/handbook.

There are strict penalties for plagiarism. Further details are available on the IoA website.

2.9 Avoiding Plagiarism

The term “plagiarism” means presenting material (words, figures etc.) in a way that allows the reader to believe that it is the work of the author he or she is reading, when it is in fact the creation of another person.

In academic and other circles, plagiarism is regarded as theft of intellectual property. UCL regulations, all detected plagiarism is to be penalized and noted on the student’s record, irrespective of whether the plagiarism is committed knowingly or unintentionally. The whole process of an allegation of plagiarism and its investigation is likely to cause considerable personal embarrassment and to leave a very unpleasant memory in addition to the practical consequences of the penalty. The penalties can be surprisingly severe and may include failing a course or a whole degree. It is thus important to take deliberate steps to avoid any inadvertent plagiarism. Avoiding plagiarism should start at the stage of taking notes. In your notes, it should be wholly clear what is taken directly from a source, what is a paraphrase of the content of a source and what is your own synthesis or original thought. Make sure you include sources and relevant page numbers in your notes.

When writing an essay any words and special meanings, any special phrases, any clauses or sentences taken directly from a source must be enclosed in inverted commas and followed by a reference to the source in brackets. It is not generally necessary to use direct quotations except when comparing particular terms or phrases used by different authors. Similarly, all figures and tables taken from sources must have their origin acknowledged in the caption. Captions do not contribute to any maximum word lengths.

Paraphrased information taken from a source must be followed by a reference to the source. If a paragraph contains information from several sources, it must be made clear what information comes from where: a list of sources at the end of the paragraph is not sufficient. Please cite
sources of information fully, including page numbers where appropriate, in order to avoid any risk of plagiarism: citations in the text do not contribute to any maximum word count.

To guard further against inadvertent plagiarism, you may find it helpful to write a plan of your coursework answer or essay and to write the coursework primarily on the basis of your plan, only referring to sources or notes when you need to check something specific such as a page number for a citation.

Collusion, except where required, is also an examination offence. While discussing topics and questions with fellow students is one of the benefits of learning in a university environment, you should always plan and write your coursework answers entirely independently.

3 Schedule and syllabus

3.1 Teaching schedule

The course will be taught in Term 2. Classes will be held on Mondays, with lectures in room 410. In weeks with deferred practical sessions (see weekly syllabus below), these lectures will last from 11:00-13:00. Otherwise, the lecture will last from 11:00-12:00, followed by a practical in room 501. In addition, a mandatory two-day field course will also take place on 17–18th February about which further details will be made available at the beginning of the course. There will be no taught class on 17th February (Reading Week). Except in the case of illness, the 70% minimum attendance requirement applies to all classes.

3.2 Detailed week-by-week syllabus

The following is an outline for the course as a whole, and identifies essential and supplementary readings relevant to each session. Information is provided as to where in the UCL library system individual readings are available.

Session 1: Introduction to Remote Sensing Techniques (KL and AB)

A brief introduction to the course followed by discussion of the main objectives of remote sensing in archaeology and familiarisation with the principal software packages that will be used throughout the course.

Practical: Introduction to AGIS lab and data processing software.

Reading


Session 2: Digital Mapping. Total station, GPS, DGPS (KL)

This lecture will introduce you to the main types of equipment available for topographic surveying: total stations, GPS and DGPS. It will outline the advantages and disadvantages of each method, their principal applications and introduce issues of data processing. We will also introduce the possible applications of LiDAR.

Practical: Deferred to Reading Week field visit (see below).
Reading


Bowden, M (ed.) 1999 Unravelling the Landscape: an inquisitive approach to archaeology, Stroud: RCHME/Tempus. (chapters 4 and 5) [INST ARCH AH BOW].


Session 3: Geophysics I. Principles and Primary Methods (KL)

This session will discuss the principals and aims of geophysical surveys, the techniques available and their limitations. It will then go on to discuss two main techniques: resistance survey and magnetometry.

Practical Deferral to Reading Week field visit (see below).

Reading


Session 4: Geophysics II. GPR, Multi-instrument Surveys and Interpretation (KL)

This session will look at the third main geophysical technique: Ground Penetrating Radar as well as some of the more unusual methods such as resistance pseudosections and magnetic susceptibility. It will then move on to discuss issues of interpretation and recent developments in the analysis and interpretation of multi-instrument surveys.
Practical  Deferred to Reading Week field visit (see below).

Reading


Conyers, L. 2012. *Interpreting ground-penetrating radar for archaeology*. Walnut Creek, California: Left Coast Press. [INST ARCH AL 12 QTO CON]


Session 5: Integrating Digital Maps and Geophysics Data (KL/AB)

Ground-based geophysical survey gains much from being integrated with a variety of other datasets including air- or satellite-borne imagery and digital elevation models. This session will look at issues surrounding the creation of digital elevation models, and the integration of geophysical data into GIS. We will also look at recent work on geophysical ‘data fusion’.

Practical  DEM construction; post-processing of geophysics data; integration of results.

Reading


Session 6: Introduction to Aerial and Satellite-borne imagery (AB)

Aerial and satellite imagery has become a fundamental feature of landscape survey in archaeology and we introduce the use of these methods, with particular emphasis on longitudinal comparisons of such imagery (e.g. of historic air photos) and on best practice for processing and combining their insights.

**Practical**  Acquisition of imagery, georeferencing, photo mosaics, metadata

**Reading**

Wilson, D.R. 2000 *Air Photo Interpretation for Archaeologists*, Oxford: Tempus

Session 7: High resolution and multi-spectral imagery. Basic methods (MA)

Fine-scale air photos and, increasingly, high-resolution satellite imagery provide information at spatial scales that are particularly appropriate for archaeological prospection. Multi-spectral imagery provides yet a wide range of information about the earth’s surface. Here we consider how such datasets support the creation of base mappings for archaeological projects.

**Practical**  Air photos and Quickbird imagery, pan-sharpening, pseudo-true colour and false colour composites.

**Reading**

De Laet, E., V. Paulissen and M. Waelkens 2007 “Methods for the extraction of archaeological features from very high-resolution Ikonos-2 remote sensing imagery, Hisar (southwest Turkey), *Journal of Archaeological Science* 34: 830–41. [UCL eJournals]

Session 8: Multi-spectral imagery. Advanced methods (MA)

Most effective remote sensing applications ultimately go further than just simple band combinations and close human scrutiny. Instead, they usually deploy a range of data generalisation or clustering techniques to suggest multivariate trends that are not intuitively obvious. This
We consider Principal Component Analysis (PCA) and classifications that involve formal ground-truthing as well as those that do not.

**Practical** Data fusion techniques, PCA transformation, unsupervised classification, supervised classification, feature extraction.

**Reading**


**Session 9: LiDAR, SAR and hyperspectral imaging (MA)**

We consider the use of other remote sensing techniques, especially those that now offer particularly high levels of detail in terms of either ground resolution (LiDAR) or spectral range (hyperspectral).

**Practical** LiDAR or hyperspectral image manipulation

**Reading**


**Session 10: Computer vision. Object and landscape models (AB)**

In the last few years, a major innovation has been the ability to construct 3D models of terrain or artefacts with nothing more than ordinary digital photographs. This is likely to lead to major changes in the nature of archaeological recording over the next few years. We consider how best to implement these methods.

**Practical** Photographic strategy, masking, model construction.
Reading

4 Online resources
The full UCL Institute of Archaeology coursework guidelines are given here: http://www.ucl.ac.uk/archaeology/administration/students/handbook.
Information will also be posted on Moodle for course ARCL3065.

5 Additional information
Libraries and other resources
In addition to the Library of the Institute of Archaeology, other libraries in UCL with holdings of particular relevance to this degree are the main library in science and engineering.

Attendance
A register will be taken at each class. If you are unable to attend a class, please notify the lecturer by email. Departments are required to report each student’s attendance to UCL Registry at frequent intervals throughout each term. Students are expected to attend at least 70% of classes.

Information for intercollegiate and interdepartmental students
Students enrolled in Departments outside the Institute should collect hard copy of the Institute’s coursework guidelines from Judy Medrington’s office.

Dyslexia
If you have dyslexia or any other disability, please make your lecturers aware of this. Please discuss with your lecturers whether there is any way in which they can help you. Students with dyslexia are reminded to indicate this on each piece of coursework.

Feedback
In trying to make this course as effective as possible, we welcome feedback from students during the course of the year. All students are asked to give their views on the course in an anonymous questionnaire which will be circulated at one of the last sessions of the course. These
questionnaires are taken seriously and help the Course Co-ordinator to develop the course. The summarised responses are considered by the Institute’s Staff-Student Consultative Committee, Teaching Committee, and by the Faculty Teaching Committee.

If students are concerned about any aspect of this course we hope they will feel able to talk to the Course Co-ordinator, but if they feel this is not appropriate, they should consult their Personal Tutor, the Academic Administrator (Judy Medrington), or the Chair of Teaching Committee (Dr. Mark Lake).

6 How to upload your work to Turnitin

Note that Turnitin uses the term ‘class’ for what we normally call a ‘course’.

1. Ensure that your essay or other item of coursework has been saved properly, and that you have the Class ID for the course (594879) and enrolment password (this is IoA1314 for all courses this session — note that this is capital letter I, lower case letter o, upper case A, number 1, number 3, number 1, number 4)

2. Click on http://www.submit.ac.uk/ (NB Not www.turnitin.com, which is the US site) or copy this URL into your favourite web browser

3. Click on ‘Create account’.

4. Select your category as ‘Student’.

5. Create an account using your UCL email address. Note that you will be asked to specify a new password for your account — do not use your UCL password or the enrolment password, but invent one of your own (Turnitin will permanently associate this with your account, so you will not have to change it every 3 months, unlike your UCL password). In addition, you will be asked for a “Class ID” and a “Class enrollment password” (see point 1 above).

6. Once you have created an account you can just log in at http://www.submit.ac.uk and enrol for your other classes without going through the new user process again. Simply click on ‘Enroll in a class’. Make sure you have all the relevant ‘class IDs’ at hand.

7. Click on the course to which you wish to submit your work.

8. Click on the correct assignment (e.g., Essay 1).

9. Double-check that you are in the correct course and assignment and then click ‘Submit’

10. Attach document as a “Single file upload”.

11. Enter your name (the examiner will not be able to see this).

12. Fill in the “Submission title” field with the right details: It is essential that the first word in the title is your examination candidate number (e.g., YGBR8 In what sense can culture be said to evolve?), and not your name.

13. Click “Upload”. When the upload is finished, you will be able to see a text-only version of your submission.

14. Click on “Submit”.
If you have problems, please email the Turnitin Advisers on ioa-turnitin@ucl.ac.uk, explaining the nature of the problem and the exact course and assignment involved.

One of the Turnitin Advisers will normally respond within 24 hours, Monday–Friday during term. Please be sure to email the Turnitin Advisers if technical problems prevent you from uploading work in time to meet a submission deadline — even if you do not obtain an immediate response from one of the Advisers they will be able to notify the relevant Course Coordinator that you had attempted to submit the work before the deadline.