Durham University

Computer Science

Summative Assignment

Module code and title	COMP4097 Advanced Computer Graphics and Visualisation
Academic year	2022/23
Submodule title	Visualisation
Coursework title	Visualisation Coursework
Coursework credits	5 credits
Lecturer	George Koulieris
Deadline*	Thursday, May 04, 2023 14:00
Hand in method	Ultra

Additional coursework files	Moon dataset (textures & elevation maps) from the Lunar Reconnaissance Orbiter, additional links including PyGMT tutorials and guidance.
Required submission items and formats	Please submit a compressed archive (.zip) with: (a) all your source code. Your program should run by simply calling `python3 problemX.py`, where `X` is 1 or 2. Include a readme file with instructions on how to run your program and what external resources you require if this is not obvious. (b) A .pdf report no longer than 6 pages including images (max ~2500 words). At the top of the first page of the document identify yourself using your CIS username. (c) A short video demonstrating the two visualisations and interaction (compressed to <100MB).

*** This is the deadline for all submissions except where an approved extension is in place. Late submissions received within 5 working days of the deadline will be capped at 40%. Late submissions received later than 5 days after the deadline will received a mark of 0.**

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COMP4097 Summative Assignment Part 2
Visualisation

Important, please read first!

- The assignment should be submitted via Blackboard; the deadline is May 4^{th}, 2pm. All deadlines can be found in SharePoint.
- Your software will be tested and should work with Python 3.11.1. You can use additional Python libraries to achieve any additional functionality (e.g., NumPy).
- Please submit a compressed archive (.zip) with (a) all your source code. Your program should run by simply calling `python3 problemX.py`, where X is 1 or 2. Include a readme file with instructions on how to run your program and what external resources you require if this is not obvious. (b) A .pdf report no longer than 6 pages including images (max ∼2500 words). At the top of the first page of the document identify yourself using your CIS username. (c) A short video demonstrating the two visualisations and interaction (compressed to <100MB).
- The marks available for correct implementations/answers to each question are indicated. Partial credit will be given for good attempts.
- The level of achievement (good/very good/excellent/etc.) for each marking criterion is determined based on the marking and classification conventions published in the university core regulations (pp 15-16): link.
- The Visualisation sub-module contributes 50 marks, i.e., 50% of the total module mark and is only assessed by this coursework.
- A FAQ section in Blackboard will be updated with questions as they arise.

The NASA Artemis 3 mission will take people back to the Moon. As the lead NASA visualisation engineer you have been tasked to create two interactive visualisations of the Moon. The first is an exploratory visualisation for scientists to gain insight on the geography of the Moon, aiding the discovery of the next landing spot. The second will be used to communicate to the general public facts about the mission, i.e., an easy-to-digest visualisation to help justify the cost of building Artemis, to the taxpayers.

The visualisations will be based on real data of the Moon (source & more info, a very interesting read), collected by the Lunar Reconnaissance Orbiter Camera (LROC) & laser altimeter, onboard the Lunar Reconnaissance Orbiter (LRO). You will be combining satellite imagery of the Moon with surface elevation data to create compelling interactive maps. All data are provided in Blackboard, in several resolutions. Low resolutions facilitate faster development, higher resolutions can be used to create stunning screenshots for your report.

To visualise the data you will be using Python and the open source library PyGMT. You can find a lot of helpful documentation in the PyGMT web pages, here and here. Your software should include a simple GUI to control certain aspects of the visualisation as required by the problem descriptions below.

PROBLEM 1, EXPLORATIVE VISUALISATION - 20 MARKS:

Create maps of the Moon to effectively illustrate the different surface elevation in its various areas, to help scientists pick a safe place (e.g., avoid the rim of a crater!) to land Artemis 3. The user should be able to zoom-in from the global view of the Moon map to smaller patches, by selecting them in the global view, and sample the heights by pointing / clicking on the map. The generated maps should compare *3D perspective displacement map* rendering to using *isolines / isocontours*. The user should be able to modify the parameters of each visualisation technique, for example, for which heights isolines are generated. A GUI should be provided to achieve this goal, enabling interactive map generation. Add any additional control / effects that you consider important to optimise the efficacy of the visualisation in understanding the Moon's surface elevation. Part of the assessment is to show a creative combination of different techniques to visualise the Moon surface. Discuss in the report the advantages and disadvantages of each method.

PROBLEM 2, VISUALISATION FOR COMMUNICATION - 15 MARKS:

The second visualisation should be appropriate for the general public. The interactive visualisation should be a *combination* of scientific visualisation, information visualisation and info-graphics to convey general facts about the mission. The choices made and approaches followed should be consistent with good practices for scientific and information visualisation as discussed during the lectures. A GUI should be provided to enable interactivity as you see fit. Use the provided Moon dataset creatively. As in the previous question, part of the assessment is to show a creative combination of different techniques. Your design choices should be discussed in the report.

PROBLEM 3, REPORT & VIDEO - 15 MARKS:

Compile a report (no longer than 6 pages including images (max $\sim$2500 words)), discussing the reasoning behind your choices for the above problems. Include images that show the generated maps. For problem 1, you should discuss the advantages and disadvantages of each method (displacement maps/perspective images vs isolines). Include maps for different parts of the Moon and at different scales. For problem 2, discuss your thought process behind the creation of your visualisation for the general public.

Please attach a short video (compress to $<$100MB) demonstrating your two visualisation techniques, for a few selected parameters. Finally pick a landing site, show it in a screenshot, and justify your choice (you cannot lose marks for this!).