

Moonbased Ham Repeater Station Project

Dr. Carlos Mascareñas (EA7GWJ)¹, Ana I. Vázquez²

^{1,2}Department of Techniques and Sciences of the Navigation and Naval Shipbuilding. University of Cádiz. Spain.

Abstract

The use of amateur satellites suffers from coverage problems.

Why not use the Moon as a repeater base? [1]

What are the challenges that Hams and students will have to face to solve them?

Even though it's a little "crazy", who says it won't be possible in 30 or 50 years?

Introduction

The **Moon** is Earth's only natural satellite.

At about one-quarter the diameter of Earth, it is the largest natural satellite in the Solar System relative to the size of a major planet.

Orbiting Earth at an average distance of 384,400 km.

The Moon's orbit around Earth has a sidereal period of 27.3 days.

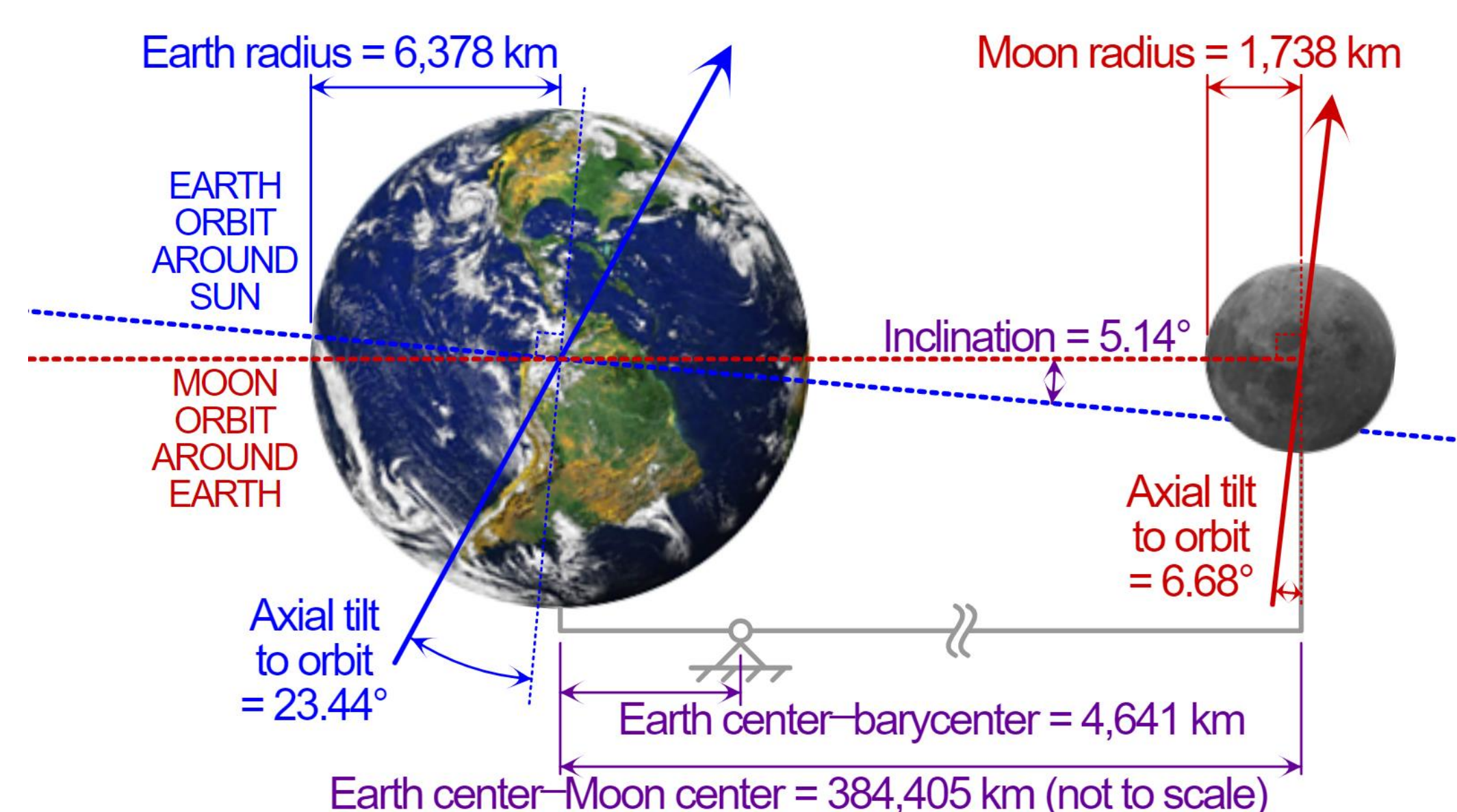
The Moon's apparent size is nearly the same as that of the Sun, allowing it to cover the Sun almost completely during a total solar eclipse.

The first artificial object to reach the Moon was the Soviet Union's Luna 2 uncrewed spacecraft in 1959.

The only human lunar missions to date have been those of the United States' Apollo program, which landed twelve men on the surface between 1969 and 1972.

The synchronous rotation of the Moon as it orbits the Earth results in it **always keeping nearly the same face turned towards the planet**. The side of the Moon that faces Earth is called the near side, and the opposite the far side. The far side is often inaccurately called the "dark side", but it is in fact illuminated as often as the near side: once every 29.5 Earth days.

During new moon, the near side is dark and very cold. At the full moon the Surface is very hot.



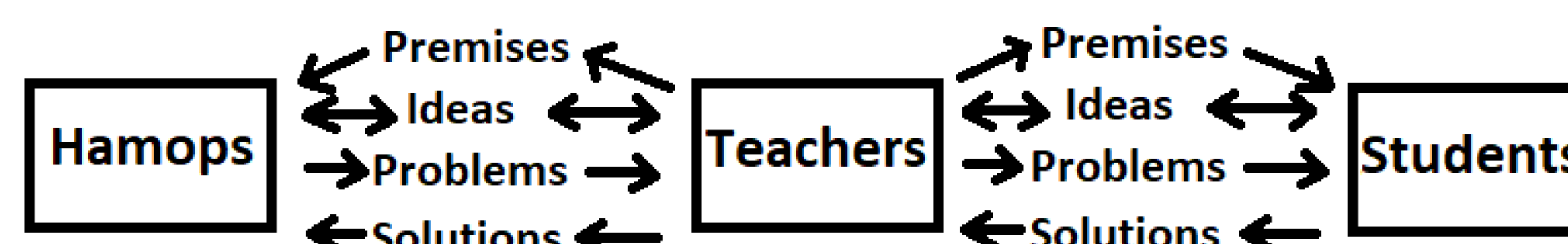
Method/Experiment

In the School of Marine, Nautical and Radioelectronic Engineering (EIMANAR), at the University of Cádiz, future Radioelectronic Officers of the Spanish Merchant Marine are trained, and they must complete an End of Studies Project in order to achieve the Degree in Radioelectronic Engineering [2].

Therefore, as teachers we must tutorize this work and propose challenges that they can solve theoretically or practically if possible.

At the same time, the drawbacks of this type of communication are exposed to the hamradio community using the interactive forum [3] of the Union de Radioaficionados Españoles (URE), which are transferred to the students, along with their own ideas and observations, making a real link between amateurs and future professionals.

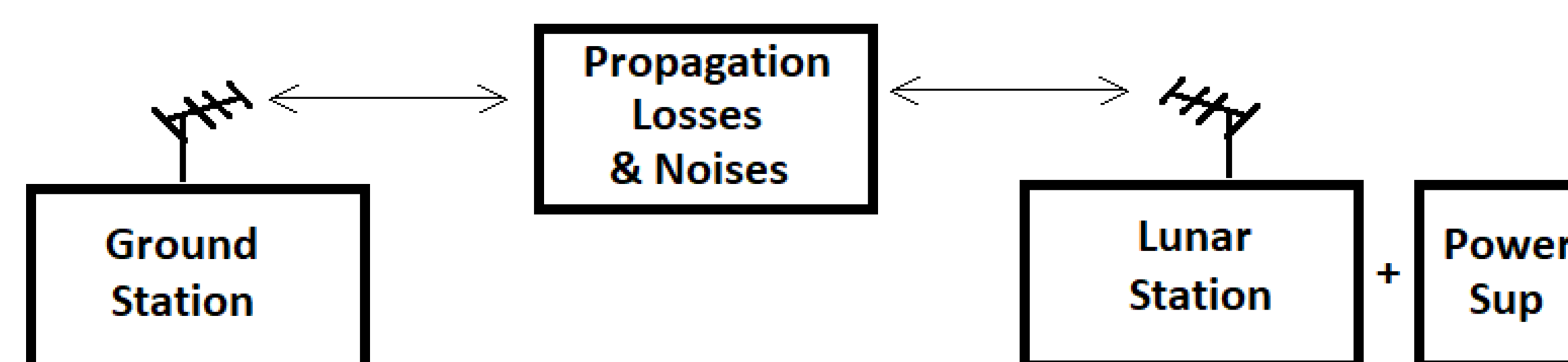
The feedback from the students is harshly criticized by the Hams, but always in a positive way. In the same way, students research for scientific and technical answers to the amateur ideas, thus closing the learning loop.



Data and Analysis

The data we are using to carry out these projects are the mathematical models accepted by the international scientific community and the comments of fans of the Moon bounce and geostationary satellites, such as QO-100 [4].

In this case we do not need to consider the propagation losses on the return trip and the surface reflection losses, since an active repeater with amplifier and directional antenna would be used.



Conclusion

The main benefit that we are achieving with the students is to open their minds to problems that are not solved at school if different knowledge acquired in different subjects is not integrated.

This is the purpose of the End of Studies Project, but analyzing known examples and applying them (design by analysis) is not the same as integrating knowledge to design (analysis by synthesis).

On the other hand, the use of amateur bands for experimentation means that the student has access to equipment with which to verify that theory does not always adapt to practice. Then you will have to look for the limits in the mathematical model and see if you have to apply another model or change the value of any parameter.

In addition, the radioengineering knowledge, propagation, antennas, modulation, equipment, must be integrated with the knowledge of astronomy, meteorology, automatic control, power systems, protection against radiation, EMC and others.

At the moment, two students have shown interest in carrying out this theoretical project and that it should be developed in parts with the help of a larger number of students.

Therefore, the technical bases of both the ground station and the Lunar station are being established.

The attenuations in the transmission and reception frequencies are very important to determine the working bands and type of antennas, but receiving community ground stations can be used to facilitate the access of all radio amateurs to the system, as is done with the QO-100[4] and the Websdr.org.

Others points of discussion is the perpetual power supply system of the lunar station and the propagation delay that would limit the speed of data transmission and, therefore, the transmission mode.

[1] <https://forums.qrz.com/index.php?threads/repeater-on-the-moon-why-not.40225/>

[2] <https://nauticas.uca.es/grado-en-ingenieria-radioelectronica-guia-docente/>

[3] <https://www.ure.es/foros/temas-diversos-miscelanea/sobre-la-posibilidad-tecnica-de-instalar-un-repetidor-de-radio-en-la-luna-en-serio/>

[4] <https://eshail.batc.org.uk/nb/>