



## The Acoustic Modem Designers

From left to right: Gaelle Isabelle Protat, Rahul Kopikar and Francisco Rafael Bastistas,

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Rahul, Gaelle and Rafael designed a software OFDM modem that plays and records .wav files to transmit files of data. They completed their project in the Academic year 2002. A fully functional version of the acoustic modem they designed can be downloaded [here](#) (the modem transmits .txt files). Please read the [instructions](#) and be quiet ☺ while the modem is running. The rate achievable with this version is about 2Kbps. You can read the details of the implementation in the [report](#). This modem is a proof of concept and new more efficient versions are under study.

### Project Motivation

Are you looking for a cheap way to build a wireless communication experiment? You can look closer than you think, since your PC is equipped with one: speaker phones create acoustic waves that can be detected by a microphone. Voila', this is your wireless communication link. Preparing the experiment is easy: you can transmit signals designed totally digitally by loading the signal samples in a .wav file and you can receive and sample the same signal by recording the sound using a microphone. And you can do it through Matlab directly. However, to make it work you cannot throw binary digits in the .wav file, you need to know a trick or two in modem design: in fact there are several effects which do not allow you to do so, some are due to the fact that the

interface is not designed for this scope. When building a wireless modem you have to be prepared to combat them with a good design.



transmitting antennas



receiving antenna

Speakers and microphones are equipped with filters that attenuate low and high frequency components. As a result the frequency response of the system is not flat. You also have quantization, which might have an impact on the choices you make in the design. In addition, since nothing is perfect in this world, you are going to notice that your digital to analog and analog to digital conversions are not perfect and time variations in the channel are introduced by the imperfect match between sampling and pulse shaping rates. Also, you better be silent when you transmit, if you do not want to cause impulse noise.

The problem that you encounter is a "toy" version of what you deal with in the designing a software for any modem operating at RF. In addition, acoustic waves are used to transmit underwater where your modem could be running just as it is.

Finally, there is an amusement in running your experiments that you cannot have when you use RF frequencies: you are equipped with sensors (your ears) that make you part of the live experiment.