

# Moirai Biodesign creates an innovative synthetic RNA design software that will propel the development of state-of-the-art therapies, diagnostic methods and vaccines

**Moirai Biodesign, a biotech startup led by expert researchers in computational biology and synthetic biology, makes the tool available to the scientific community free of charge and offers its services and knowledge to the industry and the academia.**

**Barcelona, June 18th, 2021.** [Moirai Biodesign](#) – a biotech startup located at the [Barcelona Scientific Park](#), pioneer in the development of RNA-based solutions for the development of new therapies and diagnostic systems– has launched [MoiRNAiFold](#), a best-in-class software for the design of complex RNA molecules.

The biotech startup, currently led by **Amadís Pagès** (CEO), **Ivan Dotu** (CTO) and **Daniel Poglayen** (CPDO), makes this tool available to the scientific community, free of charge, as a web server.

RNA, or ribonucleic acid, molecules are absolutely essential for life. They transport and express the genetic information encoded in the DNA, playing a key role in almost all cellular functions. Our ability to design new RNA molecules is therefore directly related to our ability to control gene expression and regulate these cellular functions.

It is for this reason that, in the recent years, scientists have raced to design and create new synthetic RNA molecules (RNA molecules that are synthesized in the laboratory) and to improving the computational tools to perform this task, in order to reduce the time and cost of developing new diagnostic and therapeutic technologies.

## A revolution in Biosciences

The therapeutic application of synthetic RNA is very innovative and has great medical and pharmacological potential, as it opens the door to a new generation of targeted therapies for certain pathologies -neurological, congenital, oncological, neurodegenerative, etc.- as well as for the development of new antibiotics and vaccines. Although mRNA-based (messenger RNA) vaccines are the best-known therapeutic application today, there are many other RNA molecules for therapeutic purposes, such as siRNAs (small interfering RNAs) or ASOs (AntiSense Oligonucleotides).

*“One of the greatest advantages of synthetic RNA therapeutic approaches is the ability to adapt quickly to new pathogens or diseases. Recently, a large number of articles have been published regarding RNA-based patents and commercial applications (related, among others, to vaccines, other therapies, and diagnoses) that show an enormous potential or that are a radical success. For example, in the context of the current pandemic, Moderna and Pfizer / BioNtech have developed synthetic mRNA vaccines to induce immunity, winning the race to produce the first vaccines against the new SARS-CoV-2 coronavirus”,* explains **Amadís Pagès** (Ph.D.), CEO and co-founder of Moirai Biodesign.

*“We firmly believe that synthetic RNA has sparked a revolution in the biotechnology industry, a revolution that has gained a lot of momentum in recent years. A revolution that, without doubt, will completely reshape the industry. And we are proud to be a part of it!”*, he adds.

## Architects of RNA

RNA molecules, like DNA molecules, are made up of a chain of nucleic acids, but the former fold quickly into a thermodynamically stable structure. This final structure determines which components of the cells they interact with and what their functions are.

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According to **Dr. Ivan Dotu** (Ph.D.), CTO and co-founder of Moirai Biodesign, *“The design of RNA structures can be substantially improved by using algorithms to predict their stability. Most RNA designs are based on a specific structure or on a change in this structure to become functional, and the designed sequences do not always fold into the desired structure, either in-vitro or in-vivo (or both), so its functionality is null or very low. Therefore, to accelerate the production time of these synthetic RNAs, better and more versatile RNA design approaches are needed.”*

Thanks to state-of-the-art artificial intelligence methodologies such as Constraint Programming (CP) and Large Neighborhood Search (LNS), MoiRNAiFold introduces new modelling concepts that aim to surpass any other functional RNA design approach, while including new dozens of design constraints, quality measures and further improved features for controlling RNA regulation of gene expression, such as the calculation of translation efficiency.

To develop this technology, Moirai Biodesign has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 712949 (TECNIOspring PLUS), as well as from the Agency for the Competitiveness of the Government of Catalonia.

*“MoiRNAiFold is an innovative tool that allows for a rapid generation of RNA molecules that fold into complex structures in a stable way and in the desired form, with a specific biological function and without the need to test thousands of designs by high-throughput assay. In general, our RNA design software outperforms all of the existing approaches (both in speed and in number of solved structures). This paves the way to efficiently generate highly structured RNA molecules that cannot be designed by any other software”,* says **Dr. Dotu**.

The results of the MoiRNAiFold studies have been published in the Nucleic Acids Research journal, issued by Oxford University Press ([DOI:10.1093/nar/gkab331](https://doi.org/10.1093/nar/gkab331)) and point to new pathways to improve computational RNA design methods.

*“We have shown that MoiRNAiFold outperforms any existing software in designing RNA sequences that are functional when validated both in-vitro and in-vivo. Our tool is able to generate, in an easy-to-use, intuitive, and versatile way, RNA molecules that are equally or more efficient than those obtained from a selection of a battery of hundreds of designs. Our approach can be applied at any time with the expectation that the number of RNA molecules to be tested will be drastically reduced without compromising functionality and therefore reducing the time and cost of production in any scenario”,* points out **Dr. Pagès**.

## ■ About Moirai Biodesign

Moirai Biodesign (<https://moirai.biodesign.com/>) is a biotech startup created in 2016 by a group of scientists, experts in the field of bioinformatics, synthetic biology, and computational biology, in order to put RNA design at the service of biomedical R&D of industry and academia. Based in the [Barcelona Scientific Park](#), the company has a multidisciplinary team of six specialists in biomedicine, biochemistry and artificial intelligence, among other areas.

The startup is in the validation phase of a diagnostic device (an in-vitro diagnostics kit), based on its own RNA biosensor technology, which initially focuses on determining the etiology of sepsis.

Since its inception, Moirai Biodesign has raised more than 1.2 million euros in private and public funding. In 2017, it was recognized with the "Innovative SME" seal, awarded by the Spanish Ministry of Science and Innovation. Ireland's RebelBio accelerator has played a very important role in driving its entrepreneurial project, as has the Ship2B accelerator. Moirai Biodesign has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 712949 (TECNIOspring PLUS), as well as from the Agency for the Competitiveness of the Government of Catalonia.

It has also benefited from the Startup Capital programme, promoted by Acció. The company has also received national funding from the Ministry of Industry, Trade and Tourism, through the ENISA Jóvenes Emprendedores line. At European level, it has received funding from EIT Health through the Headstart grant and has been the beneficiary of SME Instrument Phase I grant under the European Commission's H2020 program.

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