

Research Plan

The wave of decentralised innovation triggered by the introduction of Bitcoin and blockchain in 2009 promised to bring new solutions through the injection of a decentralised computation paradigm into well-known problems. My research focuses on some of these, namely, governance and electronic voting protocols, which are among the scientific areas that were expected to be influenced by this novel approach. My doctoral research journey has begun with an extensive literature survey on the evolution of academic e-voting proposals. This study revealed that the e-voting research community reacts quite rapidly to the introduction of new cryptographic techniques. If these display application potential in the e-voting context, their inclusion in new academic proposals happens rather quickly. From the first commercial encryption schemes up to smart contracts and distributed virtual machines, all these new technological advances found their way into electronic voting academic proposals. All except for non-fungible tokens (NFTs), one of the latest and most popular of blockchain features. NFTs provide a trustworthy method to establish ownership relations in the blockchain using a secure and transparent mechanism. Pairing this with encryption techniques, NFTs also provide a privacy-preserving method for committing information to a blockchain via their metadata properties, making them particularly attractive to use as vote ballots in a decentralised e-voting platform. Yet, so far, no academic proposals have been submitted exploring this approach to e-voting. NFTs were adopted very quickly by the blockchain research community, and there are many examples of NFT-based academic projects, just not in the e-voting context. As such, I intend to explore this research gap by reviewing and comparing existing NFT architectures and using them to develop an NFT-based e-voting proposal to evaluate the usefulness of this feature in the overall theme of blockchain-based voting systems.

Collaboration with the University of Surrey

My doctoral program establishes a period (from a minimum of 6 months to a maximum of one year) where the doctoral research must be undertaken abroad, hosted by a foreign (non-Italian) university or research institution. I originally met some faculty members from the University of Surrey during a prior research collaboration on the “Transition Guardian” line of research. My advisor team in Pisa has also collaborated with Surrey in several activities in the past related to blockchain research. I can also draw from my own very positive past experiences residing and working within the United Kingdom. Most important of all, the University of Surrey is a perfect fit for my PhD research topic, as it hosts the Surrey Centre for Cyber Security, a renowned centre for electronic voting-related research, among other relevant areas, such as privacy and authentication, trusted computing and systems, and security verification, all areas that overlap significantly with my main research topic. If agreed, the expectation is to start this collaboration in February 2025. I’m planning to have an NFT architectural comparison article ready for submission by that time, so I expect to use the bulk of this period to continue and finalise the development of an NFT-based e-voting system, to later proceed to the experimental results phase. The expectation is to publish a critical article detailing this proposal, supported by an experimental evaluation. I do hope to make this collaboration opportunity as reciprocal and open as possible. During this period, I’m also expecting to collaborate on research opportunities from the faculty adjacent to the main context of my research.