The Technological Emergence of Quantum Communication: A Patent Analysis

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EXTENDED ABSTRACT

Quantum communication is important for information security and is applied in many area including military, finance, and social development. Many countries/ regions propose strategic plans about promoting the development of quantum technology. For example, China proposed "quantum technologies" as a national strategy and promote it vigorously. The White House National Quantum Coordination Office released "A Strategic Vision for America's Quantum Network". The European Union launched the Quantum Technologies Flagship and proposed the Strategic Research Agenda on Quantum technologies.

Emerging technologies can have revolutionary influence on science, the economy, and society. Academics make great effort to identify emerging technology(Zhang et al., 2019; Carley et al., 2018; Zhang et al., 2021; Xu et al., 2019; Breitzman and Thomas, 2015). Technological emergence indicator (TEI) considers the persistence, novelty, growth, and community to identify technological emergence (Porter et al., 2018; Carley et al., 2018). It is applied in synthetic biology, nanotechnology, genetically modified maize, and other fields. (Shapira et al., 2017; Wang et al., 2019; Liu et al., 2020) The research of evaluating the TEI show that it has great forecasting value in persistence, growth, community, and impact (Liu and Porter, 2020; Kwon et al., 2019).

This research tries to describe the development of quantum communication and identify the emerging technologies in this field. This research adopts the bibliometric analysis and the text mining methods to solve four important problems: (1) Which phase does the quantum communication technology belong to, according to the technology life cycle theory? (2) Who are the active contributors in this field? (3) What are the emerging topics of quantum communication technology? (4) How about the patent layout of quantum communication associating the patent assignees and the emerging topics?

This research develops a searching strategy for quantum communication and retrieves 4488 records by the Derwent Innovation Index in October 2021. According to the theory of technology life cycle, the quantum communication is in the growth phase. The "Growth" is shown by the number of patents, the number of inventors, and the Derwent Classifications. China, US, and JP are the leading countries. We build a collaborative network to explore the relationship between the top 30 patent assignees.

By applying the technological emergence indicators, this research identifies 146 emerging terms and classifies them into four topics: (1) the photonics issue; (2) transmission and measurement; (3) the related application of QKD; (4) the quantum random number generator (QRNG). The emerging scores of 4 topics are 37.09, 22, 28.56, and 13.54 correspondingly.

We also investigate the emerging topic distribution of patent assignees. CETC China Acad Electronics & Information achieves the highest emerging score of 202.03, but the number of publications of CETC only ranks the 7-th place. Ruban Quantum Technology Co Ltd, and Univ South China Normal take the 2nd and 3rd place respectively. From the distribution of emerging topics, the different research key points of patent assignees are explored.

In conclusion, this paper aims to give a comprehensive and in-depth analysis of the global development of quantum communication. The paper analyzes the patent data from the Derwent patent database. By applying techniques from text mining, bibliometrics, and social network analysis, this research analyzes technology emergence, explores patent layout, and identifies the key countries/regions, assignees, technology categories, and others. The research results reveal the technological emergence of quantum communication. That can provide suggestions for future research topics and promote the developemt of quantum communication for policymakers.

KEYWORDS Quantum Communication; Bibliometric Analysis; Technological Emergence Indicators; Patent Analysis

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