

A patent landscape analysis of textile sensors for muscular activity sensing of stimulation

Massimo Barbieri¹, Giuseppe Andreoni^{2,3}

1- Politecnico di Milano, Technology Transfer Office

2- Politecnico di Milano, Dipartimento di Design; 3 - Scientific Institute IRCCS « E. Medea », Bioengineering Laboratory

INTRODUCTION & AIM

The muscular activity is correlated with every human movement, thus is relevant for different perspective: gesture analysis, sport performance, clinical evaluation and rehabilitation, ergonomics and occupational biomechanics, up to fitness and body sculpturing. Muscles provide an electrical signal when contracting (EMG), and contract when electrically stimulated (FES). In both cases to record and analyze the muscular activity, at least pair of surface electrodes are placed onto the skin in correspondence of the ventral area of the muscle of interest.

In the era of smart garments, textile electrodes for EMG or FES represent a very interesting and promising area of development and exploitation. In this frame, we conducted a patent landscape analysis of textile solution for EMG sensing and FES actuation.

METHOD

The reference patent database utilized was **Espacenet**, which contains information regarding published patent applications and granted patents from over 100 patent-granting authorities.

The searches were conducted using keywords (Textile sensor, Textile sensing, Textile electrode, Electromyography, Electromyogram, EMG) exclusively, across the Title, Abstract, Claims (TAC) search fields. Keywords were combined via the AND Boolean operator with IPC/CPC symbols.

IPC/CPC symbol	Definition
A61B5/296	Electrodes for electromyography
A61B5/389	Diagnostic methods for electromyography
A61B5/313	Input circuits for electromyography
A61B5/395	Details of stimulation, e.g., nerve stimulation to elicit EMG response

RESULTS & DISCUSSION

In the present study, a total of **160** patent families were retrieved. A preliminary evaluation was conducted by implementing a filter that was designated as "*earliest priority date*," which was applied to the subset of families that had been filed within the timeframe spanning from January 1, 2014, to December 31, 2023. This initial screening process yielded a total of **124** patent families.

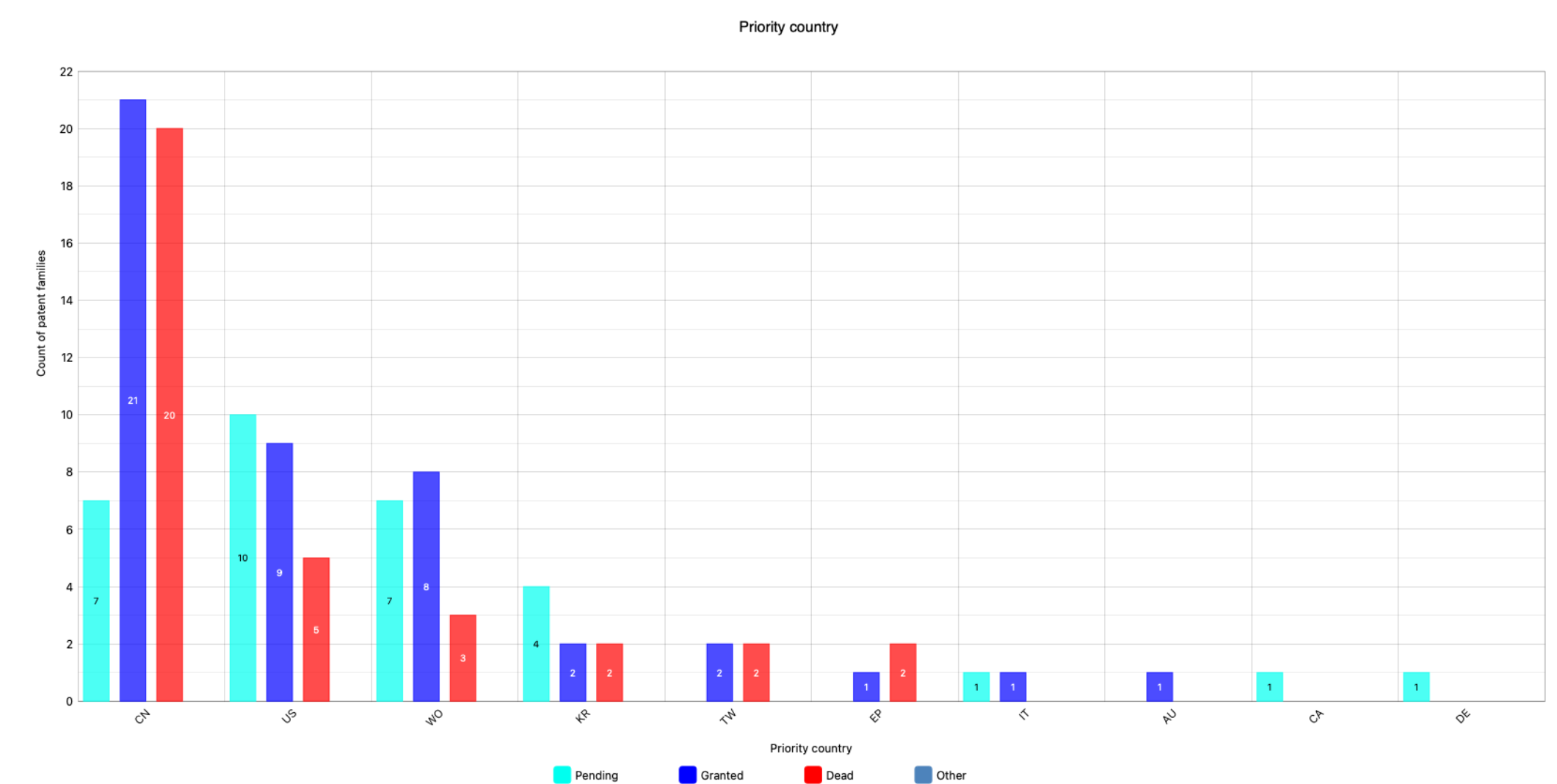
Due to the limitations of the present study, patent families with IPC/CPC subgroups {A61B5/291 – *Bioelectric electrodes for electroencephalography* [EEG]} were excluded from the analysis.

The **103** patent families were imported into **Orbit Patent Intelligence** and subsequently analyzed.

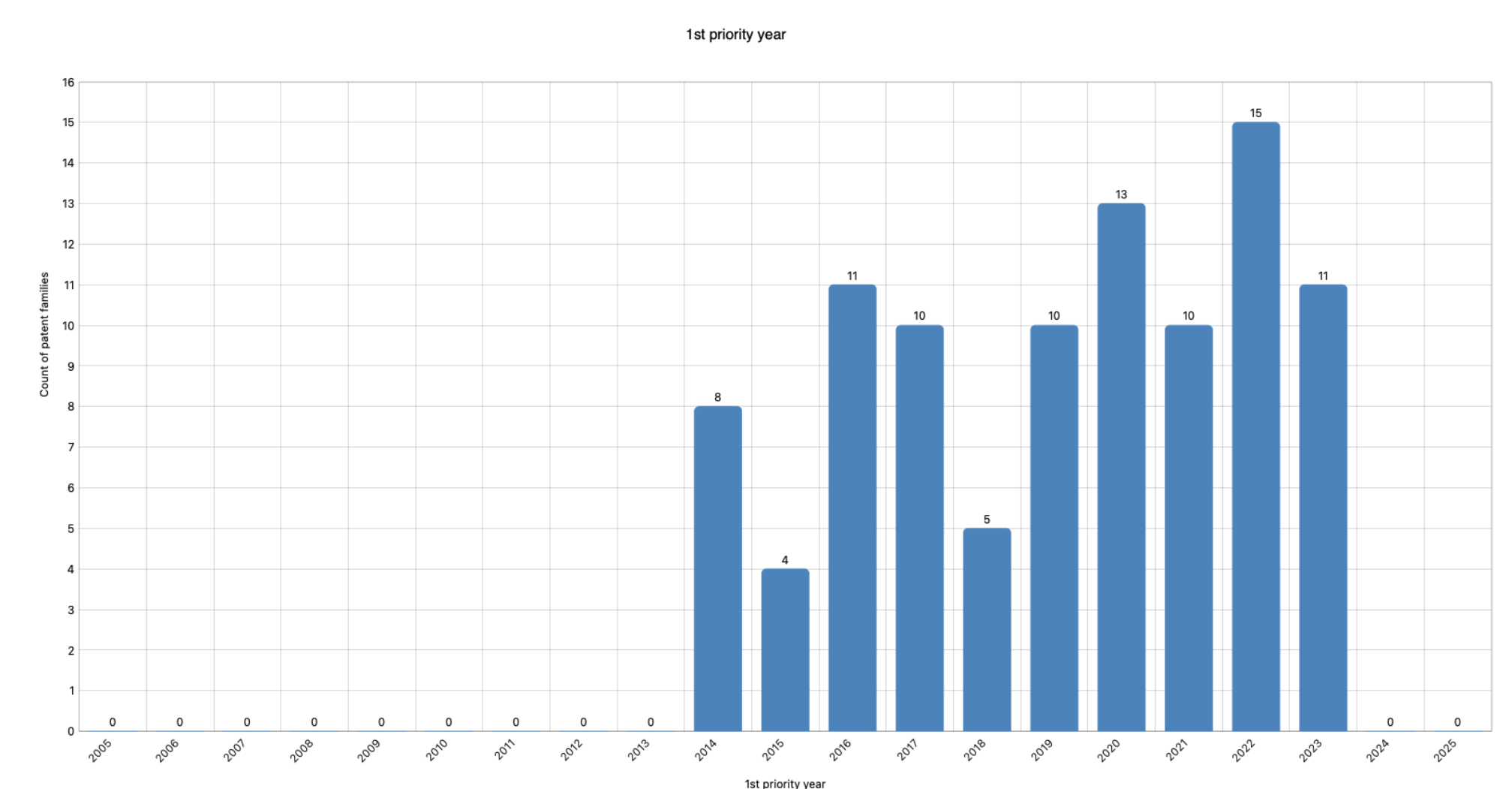
6 patent families were excluded from the study because they were deemed to be irrelevant.

The landscape analysis was conducted on a sample of **97** patent families.

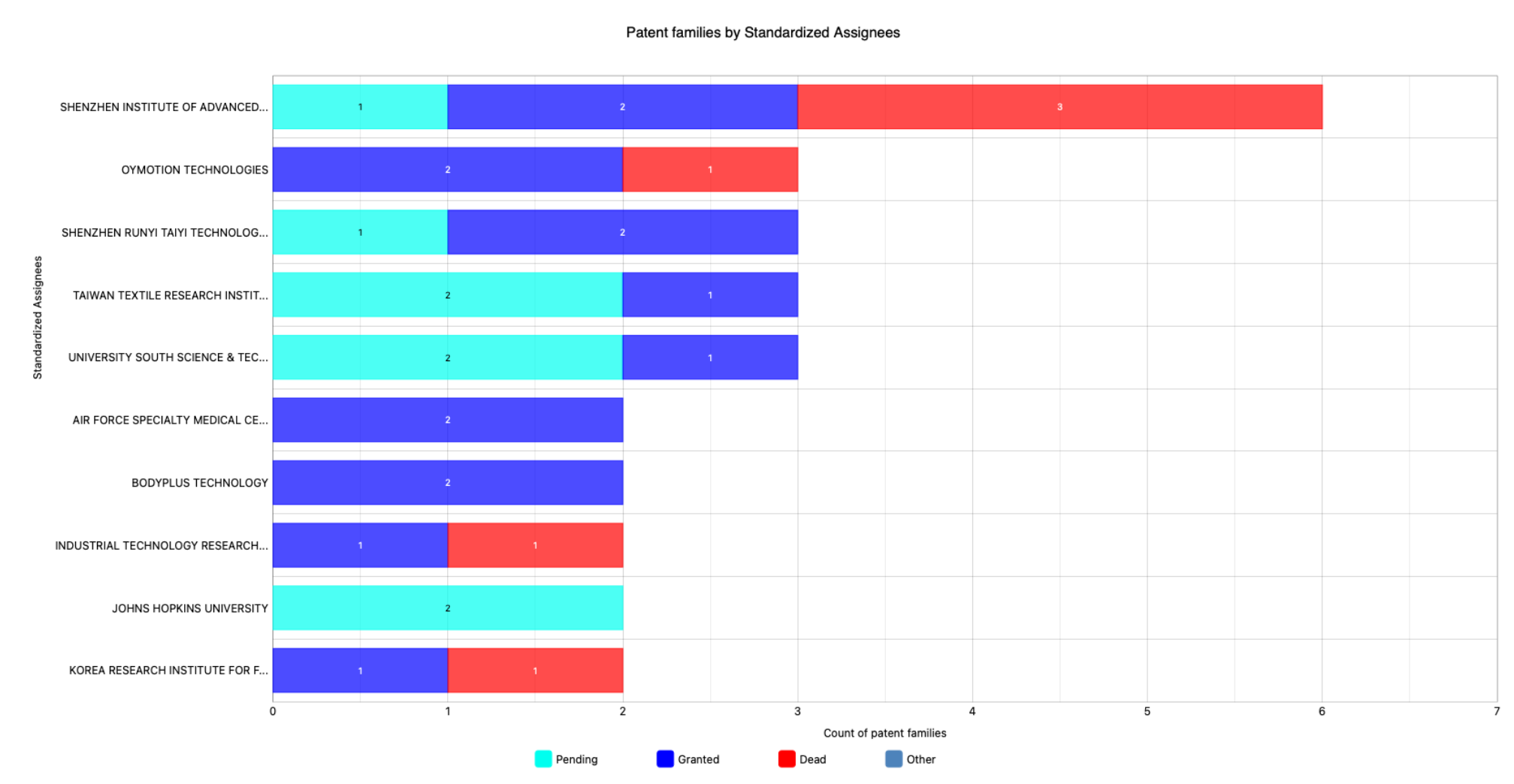
China and United States account for the majority of patents, but with China with double filings with respect to US.



The current trend indicates a decline in the number of priority filings in 2023, following a significant peak in filings observed in 2022.



The majority of the top applicants are universities or research public entities. Exploitation by licensing was not analyzed.



CONCLUSIONS

The present study demonstrates that patent filings as an indication of innovative activity in the domain of textile EMG sensors, have exhibited a relatively stable trend over the past decade. A geographic analysis of the applications reveals that a significant number of them do not demonstrate an international scope of protection, as evidenced by the absence of multiple extensions abroad.