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OCEANS '19 MARSEILLE: ANALYSIS OF THE NUMBER OF PAPERS MENTIONING MACHINE LEARNING (HTTPS://EARTHZINE.ORG/OCEANS-19-MARSEILLE-ANALYSIS-OF-THE-NUMBER-OF-PAPERS-MENTIONING-MACHINE-LEARNING/)

OCEANS '19 Marseille: Analysis of the number of papers mentioning machine learning

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A look at how common the Machine Learning theme was at OCEANS Marseille

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Machine Learning - a growing buzzword

"Deep Learning", "Reinforced Learning", and "Neural Networks" are some buzzwords that seem to recur often at every conference nowadays. Typically, these buzzwords are related to machine learning methods that loosely emulate the human ability to understand and make a knowledgeable decision based on a given set of data. Machine learning techniques aim to make inferences or models by 'learning from experience', or in other words, based on an existing dataset often known as a training dataset.

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The capabilities of machine learning are finding increasing publicity in recent times due to events such as AlphaGo defeating human Professional Go champion, Lee Se-dol [1] and OpenAI taking down the world championship team of 5 players in a multiplayer online battle arena video game [2]. Through these, it was demonstrated that machine intelligence can not only plan long-term strategies and teach itself to get better at complex human-derived constructs such as games, but that several units of them can also collaborate and team up to achieve this. The landscape in various industrial sectors is rapidly evolving into being data-centric, and numerous businesses, such as Google's search engine and Netflix's recommendation engine, are using machine learning as a catalyst to innovate their next product evolution.

Machine learning techniques have a huge potential to boost our capabilities in Ocean science as well. Oceans cover 70% of Earth, and we are collecting more and more data daily from the hydrosphere that we need to process and portray. Machine learning methods fit in well here, as they are often data hungry and are effective when provided with good, representative training data. In addition, they often provide good solutions to dealing with the problem of big data that seems intractable, by allowing us to crunch or simplify data by compressing them into good models, de-noise the data and improve its quality, or to shortlist the data to identify only the 'useful' parts that fit into our applications.

Applications

Some applications of machine learning to ocean sciences that have been explored, include

- Monitoring marine biodiversity – by identifying sounds of interest in hydrophone recordings that could correspond to vocalizations by marine mammals [3, 4, 5, 6]
- Source identification/localization – identifying sources of

acoustic noise such as ships [3]
- Fish catch forecasting [7]
- Target identification in sonar images [8]
- Data de-noising to remove outliers from bathymetric or sonar data [9]
- Modeling of deep-sea resources [10, 11, 12]
- Diver detection and tracking [13]
- Path-planning and navigation in marine robotics [14]

We look at an instance of how all these developments have impacted the academic landscape, with an overview of the number of talks on machine learning-related topics at MTS/IEEE OCEANS 2019 Marseille.

A breakdown of the numbers at Marseille

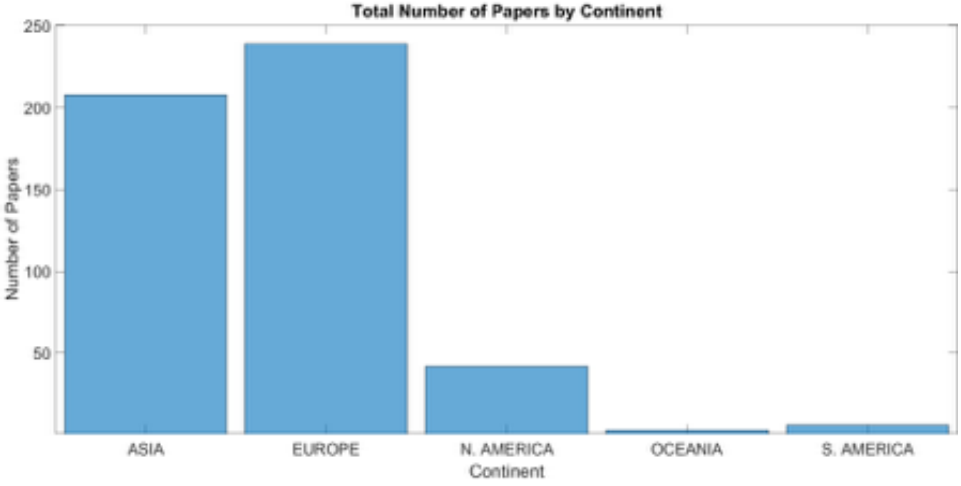

FIG. 1 - TOTAL NUMBER OF PAPERS (BY CONTINENT) PRESENTED IN OCEANS 2019 MARSEILLE.

A total of 498 conference papers were presented in OCEANS 2019 Marseille, with the majority of the papers coming from Europe (239 papers) and Asia (208 papers), as shown in Fig. 1. This information was obtained by scanning through the list of conference papers and extracting the country from the institution affiliation or address given in the paper.

From the total number of presented conference papers, 58 papers had at least one mention of machine learning or methods in this field. The mention could be part of a discussion because machine learning was used as part of the paper's research methodology, or because other literature or techniques involving machine learning were cited as part of the literature review.

In order to obtain this information, we scanned the text of the papers for words that refer to machine learning or techniques in this field (such as 'neural networks', 'reinforcement learning', or 'autoencoders'). Obviously, this method is quite simplistic and not foolproof, and it does not

represent all possible techniques in this broad and growing domain of machine learning. However, we believe it gives a general idea of how pervasive machine learning has been at this conference, aside from our personal observations from many years of attending OCEANS.

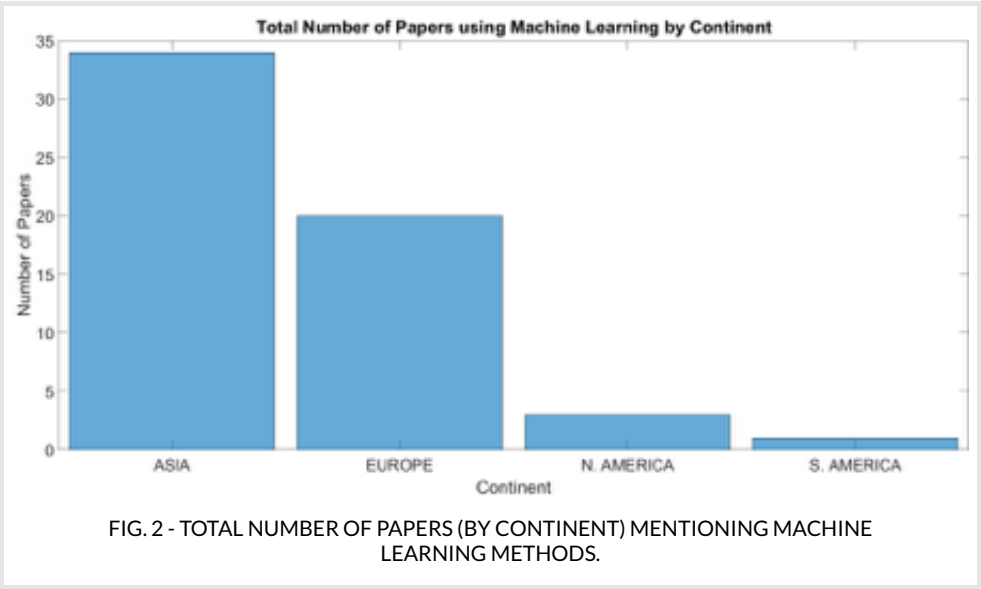

FIG. 2 - TOTAL NUMBER OF PAPERS (BY CONTINENT) MENTIONING MACHINE LEARNING METHODS.

Of the 58 papers, 58.62% (34 papers) and 34.48% (20 papers) of these papers were from Asia and Europe respectively as shown in Fig. 2.

Fig. 1 is further broken down into countries as shown in Fig. 3, where it can be seen that 31 countries [1] were represented from the 498 papers presented in OCEANS 2019 Marseille, with researchers from China presenting 156 papers followed by researchers from France presenting 82 papers. As mentioned earlier, all country affiliations were extracted from the institutional affiliations given by the authors in the papers.

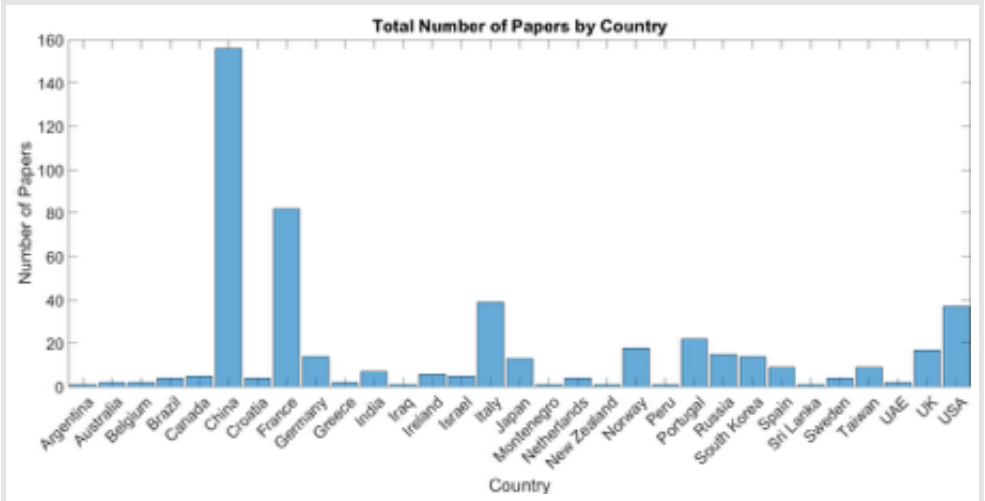

FIG. 3 - TOTAL NUMBER OF PAPERS (BY COUNTRY) PRESENTED IN OCEANS 2019 MARSEILLE.

We next zoom into the number of papers from each country that mention machine learning or related techniques, and this is depicted in Fig. 4. There were 26 papers in this category from China followed by 5 papers from each France and Norway. Seeing China lead this list and France following in at second place is not surprising given that China heavily led the number of paper submissions at the conference in Fig. 3, and France followed (possibly due to proximity).

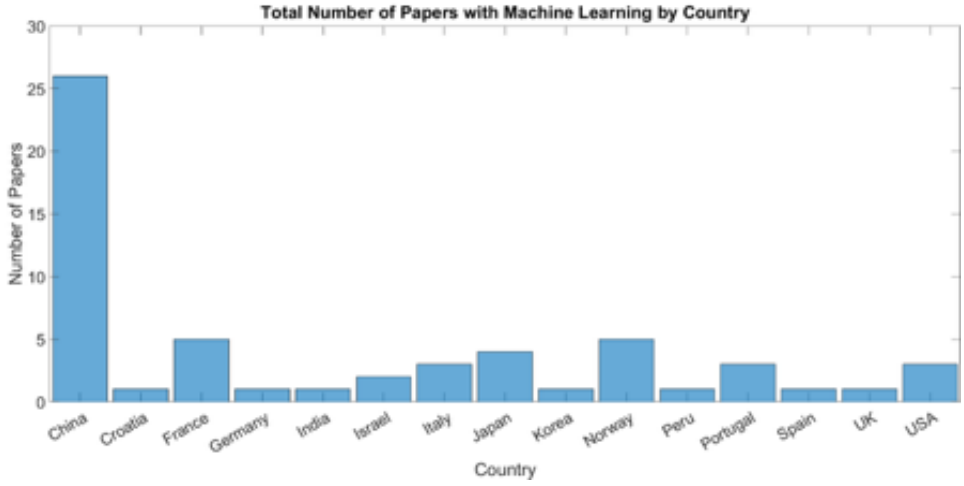

FIG. 4 - TOTAL NUMBER OF PAPERS PRESENTED (BY COUNTRY) IN OCEANS 2019 MARSEILLE THAT MENTION MACHINE LEARNING METHODS, POSSIBLY USING THEM OR REFERRING TO THEM.

This could also, in part, be a reflection of the Chinese government's determined drive in artificial intelligence. Steered by government-led policies such as "Next Generation AI Development Plan"[15] and relying on its research population of more than 1.59 million [16], China continues to establish innovation and commercialization through machine learning.

Finally, we investigate the top 5 topic tracks (in terms of number of papers) mentioning and possibly using machine learning as shown in Fig. 5. The "Sonar Signal Image Processing" track has the highest number of papers (17 papers) mentioning machine learning, followed by the "Autonomous Underwater Vehicles" track at a distant second with 4 papers. This is understandable - machine learning methods have shown stellar performance in the field of computer vision and robotics. Examples of this can be seen from the result of ImageNet competition in 2012, where deep learning achieved an improvement of 10% over previous results. The 'Sonar image processing' and 'Imaging and Vision' tracks represent ideal outlets, where the known strengths of machine learning in image-processing can be utilized.

The result of contribution from artificial intelligence is estimated to lead to a global economic growth of $US16 trillion by year 2030 [17]. Having said that, we must remember that many of the machine learning methods used today had their origin from the 1950s starting with Frank Rosenblatt's work on the perceptron, an electronics device that learns through a given dataset of example. Since then, due to various reasons such as the lack of datasets of sufficient quality, or computational

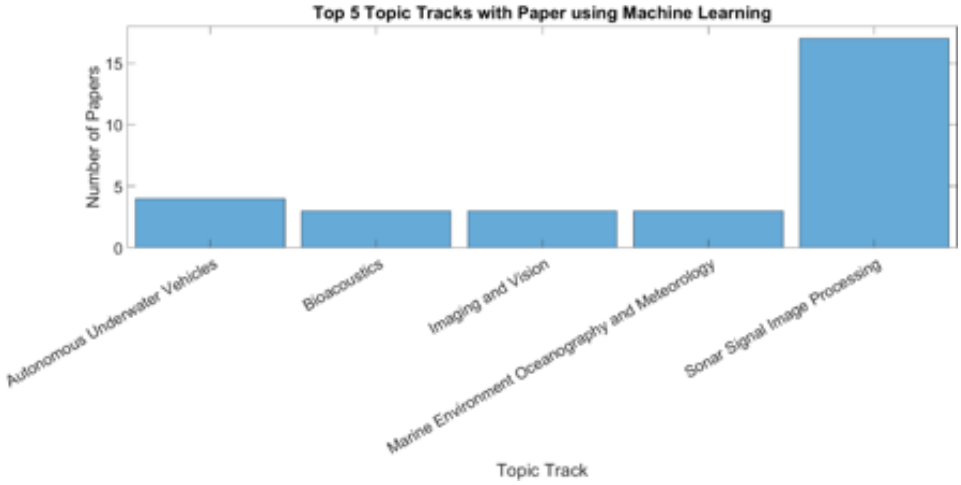

FIG. 5 – TOP 5 TOPIC TRACKS WITH PAPERS THAT MENTION MACHINE LEARNING METHODS, POSSIBLY USING THEM OR REFERRING TO THEM.

power and space, machine learning research has seen its fair share of rise and fall in popularity till date. Perhaps, with the advent of big-data methods and high-performance computing, we could now be primed to herald in the next era of technology advancement using machine learning. Hopefully, it will pave the way to turn the massive amount of data being collected in various fields of marine sciences and engineering, into knowledgeable models, inferences, actions and applications, and eventually lead to a better understanding of the world's water bodies.

Read coverage on a Hydrography workshop (https://earthzine.org/a-workshop-dedicated-to-the-world-hydrography-day-at-oceans-conference-marseille/) at Oceans 2019 conference, Oceans-related coverage on Careers for students and Young Professionals (https://earthzine.org/careers-an-ieee-oes-panel-at-oceans18-in-charleston/), or more (https://earthzine.org/?s=oceans+conference) articles covering Oceans conferences.

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