Transactions of Azerbaijan Higher Technical
Educational İnstitution
ISSN 1609-1620
Volume 22, № 6 (2020), 86-90
UDC 681.3.622.692.4

Information technology for effective management and development of Azerbaijan oil transportation system

Informatics and automatics

Majidov A.M.
Khazar University (Neftchiler Campus)
E-mail: elirza1996@mail.ru

Information and communication technology or short ICT is of great significance to nearly all aspects of oil operations. All the types of oil transport such as pipelines, trucks, ships, rails are a potential danger to the environment, safety and health. In this case, most of the time to provide safe oil transportation is used from ICTs. ICTs assist to optimize oil transport processes and so improves the performance of oil processes. This article intends the main areas of application of ICT in oil transport process.

Key words: oil transportation, information and communications technology, SCADA systems, crude oil, algorithm.

Introduction

The economy of Azerbaijan is supported by oil, which is not renewable energy source. Information technologies play significance role in many energy sector to increase efficiency and productivity. While oil importing countries try to use oil more effectively, exporting countries try to benefit the advantage of using ICTs. ICTs has a high impact in midstream oil operations. For example, while oil exporting with trunk lines, it is necessary for trunk lines to deploy sensors and communication networks, an operation where via SCADA systems controller monitoring, via PVT (pressure, volume, temperature) computational monitoring are regular affairs. In this case ICTs provide to improve oil transportation and other important oil operations.

The growth of Azerbaijan oil industry is divided into several stages. The first stage begun with mechanical manufacture of oil from 1847 and continued up to 1920. The second stage begun in 1920 and paves the period offshore Oil Rocks field in 1949. The third stage begun with operation of Oil Rocks field in 1959 and continued up to 1969. The fourth stage begun in 1969 and is characterized by the fast growth of oil industry which return back to the initial cycle of Heydar Aliyev's government. The fifth stage is characterized by the creation of the new era of Azerbaijan oil industry. These passing years, millions of crude oil tons have transported to the European countries. For comparison, with a maximum crude oil production capacity of 1 million barrels per day. In this case, the make use of ICTs in the oil sector in Azerbaijan is very useful and effective.

Statement of the problem. Transportation of oil thousands of kilometers across the country requires a reliable and efficient systems. These systems can be used to increase reliability, throughput and performance in any midstream compression, pumping applications. Each of these components is engineered to complement the others which optimizes dynamic performance and promotes energy efficiency. Most of oil countries to generate such kind of system need more new data. Be-

sides available data uses advanced analytic applications. These applications provide a single view of processes and assets and deliver predictive analytics using machine learning algorithms. Advanced analytics applications can assist oil transport process to grow margins and become more efficient in some of the following ways:

1. Smart pressure monitoring
2. Supply forecasting
3. Demand forecasting
4. Interactive operations visualization and etc.

When transport the oil from one point to another one with pipelines, pipeline pressures regularly fluctuate. These pressure drops can be happened from different causes. To avoid this process, most of time are used regulators. This regulator accurately detects those fluctuations by building automated systems and prevent to anomalies.

Sometimes it is difficult to know in advance from which well the oil and gas will enter, at what volume and pressure. That time producers need "day ahead" predictions which are subject to great uncertainty in the transportation of oil and gas processes.

In turn this process confuses to configure the pipeline to manage oil and gas volumes different from they expected. This time companies use sub-optimal configuration and as a result reduce revenues from the asset. When producers meet with this situation, may be subject to repeatable patterns and if so, via a proper forecasting algorithm can ensure useful guidance and insight as to expected volumes from producers. In addition to models through big data inputs can reveal ways that warn producers to smooth volumes for their own benefits.

During oil transport process companies distribute and produce comprehensive information on pipeline activities and conditions. Those information hold itself withdrawals, adds, storage system activities and etc. If these reports contain useful information, they ensure a static view of dynamic operation and stakeholders don't need to serve them.

Solution of the problem

SCADA Technology for Oil Transportation Operations. SCADA-Supervisory control and data acquisition systems consist of hardware and software elements to make effective process in energy sectors like the gas and oil industry. SCADA systems have the skill to process and monitor real-data time, to control processes, updates into a log file, record events and etc. Additionally these systems via human-machine interface to cooperate with devices which these devices use oil transport process such as sensors, valves and etc. Shortly, these systems communicate system problems, maintain efficiency, and for smart-decision makers process data more effectively. So, these systems can be implemented well in many fields including power, energy and transportation.

We already know that most of time to transport crude oil from drill sites to storage use pipelines. These pipelines go through hundreds of kilometers over various types of harsh territory. For this, to manage and monitor all field equipment, operators need central SCADA systems. For example, in pumping stations operators via this system can regulate pressure. Besides, operators can define, detect and solve issues like damages in these pipelines with using SCADA systems. In controlling and monitoring pipelines, these systems are less time consuming and very effective. Besides, these systems are renowned for efficiency to precise data reporting, streamline system control functions, data collection, and data communication.

These all factors which are listed above, directly depend on establishing correct database systems. That is why when engineers generate any comprehensive system, first of all, they need much more proper information about this system.

Machine learning in problem of anomaly detection of oil transportation. The development of digital technologies, such as other fields, has affected the oil industry for years, which helping to reduce costs, improve safety and production processes. Artificial intelligence and machine learning

are the two key technological attempts running the shift within the oil industry, notably in oil transportation.

Machine learning is the skill for computers "to learn without clearly programmed". Machine learning algorithms demand both standardized and quality data to reach the best outcome. That is why data must be organized in time. When data is unreliable and uncertainty, for prediction, transporting techniques can be checked using a combination of fuzzy logic and algorithms. There are many ways to solve this problem. One of these way is that looking back at past failures and appealing the lessons learned. When searching previous instances of the same problems in a case library, machine learning can widen the net and speed up this process.

Machine learning is very useful in oil and gas transportation. In the following has shown some applications:

1. Anomaly detection: One of the important and useful of machine learning application is anomaly detection in oil transport. In the close term predict, machine learning algorithms predict failures and identify patterns between valid readings. In modern midstream sector, all facility includes sensors which are remotely controlled and monitored. Approximately, a facility logs several thousand measurements per day that after cleansing and preprocessing suggest a good foundation for crating reliably prediction model of machine learning. Anomaly detection permits recognizing fault of oil transport components such as motors and valves as early as possible to suppress further losses. There are different methods to define anomaly detection. One of these methods is LODA- Lightweight Online Detector of Anomalies (Pevny-2016). A brief of explanation of this method is given in the following:

$\Pi_{1,\ldots\ldots\ldots\ldots\ldots\ldots,}\Pi_{\mathrm{M}}$ – set of M sparse random projection.

$\mathrm{f}_{1,\ldots\ldots\ldots\ldots\ldots\ldots,\ldots\ldots}\mathrm{f}_{\mathrm{M}}$ – corresponding 1-dimensional density estimator.

$S(x) = \frac{1}{M}\Sigma_{\mathrm{m}} - \log f_{\mathrm{m}}(x)$ – average surprise.

In here, given a set of data points, which creates a set of capital *M*, say 100 sparse random projections. So it randomly chooses square root of *d*, where *d* is the dimension of the data. The square root of *d* defines a random projection onto a one-dimension, and then fits a one-dimensional density model. I have drawn it as a kernel density estimate, but they actually use an adaptive histogram estimator.

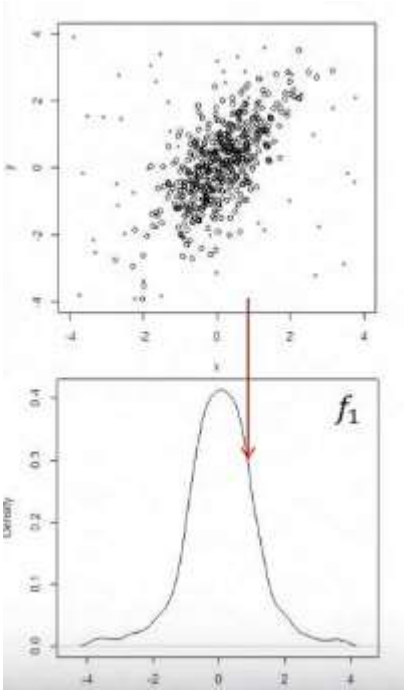

Fig.1. Kernel density estimator

What really they do? It just calculate, the average of the minus log density of a query point, so the average surprise. We can easily see, if we took a data point, which has expressed in Figure, it would have a pretty high probability in this projection. But of course, if we got some other projection, then it will be mapped to a low density tail. This is extremely simple idea, but also works surprisingly well presumably, because they are not super however interactions in our data.

2. Predictive maintenance: Apart from anomaly detection, for predictive maintenance machine learning is broadly used as an effective tool. For planned maintenance actions machine learning algorithms display times, which optimize the periodic maintenance action scheduled and prevent crash of the system. In terms of these algorithms, predictive maintenance is defined a classification problem which permits predicting of failure in the next future, or before failure a recession problem that permits predicting how much time the motors or other components is going to operate.

Conclusion

Crude oil has significant position in our economy. In this case, oil transport process must be performed high accuracy and effectively. In all oil transport processes, improved use of ICTs and related technologies can assist to solve the present difficult situation regarding oil supply in the world energy market. Besides, improving of ICTs and related technologies can help to discover new oil wells with greater precision and efficiency.

References

1. Kelly K. The Power of Advanced Analytics for Midstream Oil and Gas. // Available from: http://www.newboldadvisors.com/news/power-advanced-analytics-midstream-oil-gas-kelly-kohlleffel/ Accessed 19 April 2019. – 2015.

2. Matthew S. Midstream Automation: What is the future of Petroleum Transportation. // Available from: https://blog.sitepro.com/resources/blog/midstream-automation-what-is-the-future-of-oilfield-transportation/ Accessed 20 April 2019. – 2018.

3. Tomas Pevny. Loda: Lightweight on-line detector of anomalies, Machine Learning. – 2016. – Vol.102, № 2. – Pp. 275-304.

4. Vivek Bansal, Andrew Slaughter, Anshu Mital. Bringing the digital revolution to midstream oil and gas. Available from: https://www2.deloitte.com/insights/us/en/industry/oil-and-gas/digital-transformation-midstream-oil-and-gas.html. Accessed 22 April 2019. – 2018.

5. Valeria Jones. Machine Learning to transform Oil and Gas industry. Available from: https://www.rigzone.com/news/machine_learning_to_transform_oil_and_gas_industry-20-sep-2018-156978-article/ Accessed 27April 2019. – 2018.

6. Vinodkumar Raghothamarad. How AI and Machine Learning industry initiatives are shaping oil and gas industry. // Available from: https://www.energyworldmag.com/how-machine-learning-and-ai-industry-initiatives-are-shaping-the-oil-and-gas-industry/ Accessed 28 April 2019. – 2018.

Xülasə

Məcidov Ə.M.

Azərbaycanın neft nəqliyyat sisteminin səmərəli idarə edilməsi və inkişafı üçün informasiya texnologiyaları

İnformasiya və kommunikasiya texnologiyaları və ya qısa İKT neft əməliyyatlarının, demək olar ki, bütün aspektləri üçün böyük əhəmiyyət kəsb edir. Boru kəmərləri, yük maşınları, gəmilər, relslər kimi bütün növ neft nəqli ətraf mühitə, təhlükəsizliyə və sağlamlığa təhlükə yaradır. Bu halda, təhlükəsiz neft nəqlini təmin etmək üçün çox zaman İKT-lərdən istifadə olunur. İKT neft

nəqli proseslərini optimallaşdırmağa kömək edir və beləcə, neft proseslərinin səmərəliliyini artırır. Bu məqalədə neft nəqli prosesində İKT-nin tətbiqinin əsas sahələrinə baxılmışdır.

Açar sözlər: neftin nəqli, informasiya və kommunikasiya texnologiyaları, SCADA sistemlər, xam nefti, alqoritm.

Резюме
Маджидов А.М.
Информационные технологии для эффективного управления и развития нефтетранспортной системы Азербайджана

Информационно-коммуникационные технологии или короткие ИКТ имеют большое значение практически для всех аспектов нефтяных операций. Все виды транспортировки нефти, такие как трубопроводы, грузовики, корабли, рельсы представляют потенциальную опасность для окружающей среды, безопасности и здоровья. В этой ситуации в большинстве случаев для обеспечения безопасной транспортировки нефти используют ИКТ. ИКТ помогают оптимизировать процессы транспортировки нефти, тем самым улучшая производительность нефтяных процессов. В данной статье рассматриваются основные области применения ИКТ в процессе транспортировки нефти.

Ключевые слова: транспортировка нефти, информационно-коммуникационные технологии, системы SCADA, сырая нефть, алгоритм.