# Thesis proposal

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| **Title** | : | Extraction of evolutionary patterns in a big data context |
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## General context

Both European Union and China is experiencing population ageing. This development will jeopardize the future balance of public finance, including that of health care. Life expectancy at birth continues to rise worldwide, and in Europe, it is approaching or exceeding 85 years for women and 80 years for men. The quality of life in these extra years, experienced after age 80 or 85, is of increasing concern to authorities seeking to delay the onset of chronic diseases, senescence, functional decline, frailty and loss of autonomy. The growing number of elderly people in the French population causes increased usage of the healthcare system. In 1997, people aged 60 and over represented almost one-third of the total medical expenditure and almost half of drug expenditure, while making up only 20% of the total population. These figures highlight the impact of the increasing number of elderly people in our country.

Otherwise, improving reliability, performance, and safety are among the top priorities for industrial organisations and businesses today. They are focusing efforts and resources on controlling costs and maximising value from existing investments. Internet of Things (IoT) solutions in industrial environments can lead nowadays to the development of innovative and efficient systems aiming to enable a pervasive monitoring of industrial machinery, thus allowing the development of advanced predictive maintenance applications in the considered scenario.

Data analytics consists in developing optimization and/or machine learning based algorithms that learn to recognize complex patterns within valuable and massive data. Challenges related to that topic are numerous, and many scientific fields are involved: computer science, data science, big data, operational research, process and data mining.

## Preventive medicine

Telemedicine [1][2] has shown its effectiveness in the management of chronic diseases, such as heart failure and high blood pressure, among others. Monitoring patients with chronic diseases through the use of telemedicine is a way to optimize their care. It also offers a better quality of life for elderly patients. Telemonitoring could lead to a significant reduction in the number of readmissions, which would consequently result in lower costs for society. These solutions also encourage the accurate collection of medical data to enable improved monitoring of patient health. The objectives are thus ambitious, ranging from improved rates of morbidity and mortality, to decreased readmissions, improved quality of life and reduced economic costs.

## Preventive maintenance

The high complexity, automation, and flexibility of an intelligent factory bring new challenges to reliability and safety. Industrial big data generated by multisource sensors, intercommunication within the system and external-related information, and so on, might provide new solutions for predictive maintenance to improve system reliability.

## Machine Learning and Big Data

The use of computer science, especially machine learning [3], arrives as a solution to assist the practitioners. The literature presents different machine learning models that provide recommendations and alerts in case of anomalies, such as the case of heart diseases. The major problem of machine learning is the high dimensionality [4]. The key to the success of machine learning models is to select the best features. It can be observed in the literature that the use of feature selection techniques helped the performance of a classification algorithm in the prediction.

## Expected contribution

The main objective of this thesis consists in developing, in a Big Data context with consideration of the spatiotemporal property, innovative optimization and machine learning techniques for actively explores industrial big data processing-based predictive maintenance or aid medical decision by improving early detection of decompensation in a patient. We'll use literature data set and databases coming from our experimentations, and the volume of data is growing on a massive scale.

The work will be done in partnership with the CHRU of Strabsourg, the CHRU of Besançon in France, Monterrey Institute of Technology in Mexico and Shanghai University.

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