# Introduction

A major challenge in greenhouse crops is the inability to detect stresses and risks early enough preventing the uncontrolled spreading of stresses causing irreparable damage. Often, although the knowledge of how to handle stress is available, due to late detection it is too late to act correctly. Hence, farmers often react to wastefully. Therefore, there is a compelling need to develop an effective, affordable robotic inspection system using close sensing. In greenhouse environments, the conditions are specially controlled to maximize the crops growth rate and production, which can expose plants to biotic and abiotic risks. Due to scarce human resources, time limitations, and the high cost of current monitoring methods, mostly manual inspection procedures can lead to inaccurate use of nutrients and late detection of diseases. Also, as farm sizes increase and the availability of labor decreases, more effective agricultural practices are necessary. A high frequency, high resolution, and optimally planned crop monitoring apparatus, collaboratively supervised by a human operator to reduce cost, reinforced by agile robotics and spectral sensing technologies could lead to intelligent, efficient, safe, and more effective biotic and abiotic stress management.

The research of this thesis is part of bigger research which its objective is to develop and enable for the first time a human integrated intelligent sensory-robotic system for inspection and early detection of biotic and abiotic stresses and risks in greenhouse crops. This novel system will reduce human labor, reduce the amount of misused watering, pesticides and fertilizers, and detect and prevent in time the spreading of diseases.

This thesis will try to develop a method to find optimal manipulator kinematic design to detect stresses in greenhouse crops, using evolutionary algorithms and set-based concept approach.

This thesis focusses on a preliminary evolutionary search process. The aim of such a

preliminary process is a reduction of the amount of the considered concepts into a

the manageable subset that includes superior concepts. in the thesis, superior concepts are concepts that satisficing Window of Interest which updated dynamically during the running of the algorithm.