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**DEGREE:** Philosophiae Doctor  
**FACULTY:** Faculty of Mathematics and Natural Sciences  
**DEPARTMENT:** Department of Informatics  
**AREA OF EXPERTISE:** Electrical Engineering/Signal Processing  
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**DISSERTATION TITLE:** *Acoustic Sniper Positioning Systems*

Automatic sniper localization devices have gained popularity in recent years and some companies have launched their sniper positioning systems designed for civil protection, law enforcement, and protection of soldiers on missions where enemy snipers pose a serious threat. Strictly speaking, sniper positioning systems are passive devices designed to detect and locate, but not engage, enemy snipers.

This research work is concerned with the problem of designing robust and reliable acoustic sniper positioning systems where the sniper's location is estimated by processing the muzzle blast and the ballistic shockwave acoustic signatures associated with the firing of a gun. In real-life situations, there are many sources of interference that might prevent a straightforward usage of this acoustic information to determine the sniper's location. This is particularly true in urban environments and armed conflict zones where many different types of noise sources might be present, which introduces inaccuracies in the localization process. The sound waves can also be reflected off the surface of buildings and other objects from the surroundings producing multiple copies of the same signal (echo). This combination of factors is particularly challenging to deal with in the context of automatic acoustic sniper localization systems design.

Three specific problems related to the processing of gunshot acoustic signatures are addressed in this work: direction-of-arrival estimation, noise cancellation, and the multipath propagation effect. Propagation models for both the muzzle blast and the shockwave are analyzed and algorithms for noise cancellation, direction-of-arrival estimation, multipath propagation, and respective implementations, have been investigated and developed. Main results have been reported in a number of scientific publications.

The thesis is submitted to the Department of Informatics (IFI) at the University of Oslo (UiO) for the degree of Philosophiae Doctor (Ph.D.). The research work has been co-financed for a four years fellowship by the Buskerud University College and by SNIPOS AS.

**About the candidate:**

Antonio Ramos was born in the Cape Verde Islands (located in the west coast of Africa) where he took his basic education. He has a master degree in Electrical Engineering from the Military Institute of Engineering (IME - *Instituto Militar de Engenharia*), Rio de Janeiro - Brazil. Antonio is currently working as an Assistant Professor at the Buskerud and Vestfold University College (HBV), Norway.