

# **Advanced Signal Processing and Emerging Sensing Technologies for Assisted Living**

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## **Project Summary**

The research deals with the problem of Assisted Living using emerging technologies and smart algorithms. It addresses the challenges self-dependence living within the perimeter of homes and residences for the elderly population. Though highly technical, the research factors in culture sensitivity to privacy and monitoring and strives to provide the needed assistance, using transparent non-intrusive approaches.

The focus of the research is using emerging technologies and innovative new analyses and algorithms to the field of assisted living. We deal with information from four sensing modalities, namely, optical, thermal, pressure, and electromagnetic sensors. Our innovations are captured in radar sensing technology using EM waves, and in the fusion of radar data with the other three sensor outputs. Intra-fusion is performed among radar sensors, whereas inter-fusion is carried out between the four different types of sensors. The primary aspect underlying our research in radar is the detection and classification of falls by developing smart signal processing algorithms and reliable radar systems. Radar systems generate specific Doppler and microDoppler signatures for each human activity which are then categorized by a set of classifiers. As different classifiers may produce different decisions for the same signature, fusion methodology must be applied to combine partial decision information from each radar sensor and each classifier to form an intra-fusion of fall/non-fall decision. In essence, important features extracted from motion signatures of the different fall types are key to achieve the desired and reliable performance.

The inter-fusion of data, including radar output, is motivated by the fact that other sensing modalities also prove effective of fall detection. Since a high percentage of falls of the elderly people occur when getting in or off bed, pressure sensors placed inside the mattress may indicate, for example, a person sitting on bed side, which can precede a possible fall when standing. On the other hand, optical cameras can be employed for continuous monitoring, or they can be switched on based on likelihood of falls over certain periods or as declared by other sensors. Thermal cameras play an important role at night and in full darkness, and their use, along with optical cameras, is guided by privacy concerns and would require concession of the person being monitored.

The research aims at providing crucial and actionable intelligent data to first responders.