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Thickness Estimation of Cortical Bone Using Model Based Sparse Bayesian Learning

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Cortical thickness of tibia is very important in predicting the risk of osteoporosis and fracture. Echo-reflection is a classical model to measure the thickness. Some autocorrelation methods have been developed to estimate the time delay between multiple echoes, which is related to the thickness of the cortical bone.
In this paper, we introduce the recently Sparse Bayesian Learning (SBL) method to estimate the time delay corresponding to the external and internal boundaries of the cortical bone. The SBL method has been first developed in machine learning, and then adapted in the domain of signal recovery. This approach has proved its efficiency in producing sparse solutions, which means high resolution of the first two reflected echoes. However, the reflected signal model is based on quantitative ultrasound (QUS), which contains specific parameters which may be badly determined. An extension of the SBL formulation has been developed to adapt the model based sparse representation and address this particular issue.
The flexible received signal model provides a better accuracy than the parameter fixed model. The proposed model based SBL method is an adaptation of advanced signal processing algorithms in bone assessment. The method has been applied numerically and experimentally.