ABSTRACT

With the growing incidence and prevalence of kidney stone disease, a rapid and accurate diagnosis using CT imaging plays a crucial role in the diagnosis and treatment of stone disease. There are some failures in a manual diagnosis and 2D imaging method based because kidney stone can vary in size, shape, intensity and can spread out over the different location of the urinary tract. Stone formation associated with calcification, the consistency of stent and bone fragments may be contained on CT image in some kidney stone cases.

The purpose of this project is to develop a kidney stone classification scheme in any kidney stone cases. The first objective is to extract all of kidney stones in the urinary system simultaneously with the help of 3D segmentation. This study applied soft-organ removal, bed mat removal and noise reduction methods to extract all of stones in the urinary system simultaneously. Second objective of this study is to differentiate kidney stone and all of segmented objects in the image. Additional well-known 3D feature extraction, three modified features and two novel methods with optimized features (average HU in core region HU_{core} and core-periphery HU variation HU_{var}) were developed to extract the stone among non-stone objects. In addition, after comparing the performance of 17 feature weighting algorithms, feature selection using weight by correlation was applied to decrease number of features without losing prediction performance. Finally, kidney stone classification using the selected features evaluated over the proposed random forest classifier (RF) specifying the optimal parameter.

Result showed that the proposed noise removing methods could successfully eliminate most of the unwanted region in the image and could extract all of stones in the urinary system simultaneously. It gave the 3D output visualization with high clarity and 95.96% of support in sensitivity. In feature extraction, classification using 47 features could achieve 94.76% in accuracy, 97.67% in sensitivity and 80.96% in specificity. The feature selection could reduce 22 features from original 47 features and could improve the performance up to 94.87% in accuracy, 97.73% in sensitivity and 85.54% in specificity. When this classification model applies the proposed parameter set, its performance could improve by 95.11% in accuracy, 97.03 % in sensitivity and 85.54 % in specificity.