Generation of Beat Sound of Korean Bell with a Bicycle Rim

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This study presents a method to regenerate the beat sound of King Seong-deok Divine Bell with a bicycle rim. The bell is a representative Korean bell of which weight is 18.9 Ton, mouth diameter is 222 cm and height is 366 cm. The secret of this bell is its beautiful sound color: beat sound with large resonant sound pressure. Firstly, I investigated what size of a rim can be matched to the bell in terms of 1st modal frequency of the bell, 64 Hz. Totally 4 grades of rim diameter from 16 inch to 22 inch are measured to identify the modal frequency of ring vibration. With extrapolating the frequencies, I predict a rim diameter of 26 inch(66 cm) is appropriate. And then I confirm the frequency with a measurement of a real bicycle rim. Next, I study on the principle of beat sound with the rim. It is allowed to understand that the beat sound results from slight difference of two frequencies in a modal pair of the ring structure. In addition, I propose to use a beat map to visualize beat distribution on the circumference of the rim. Finally, I develop a design method for regenerating the beat period of the bell with a rim. As a result, the period of beat sound can be increased from the initial condition, 0.5 sec to the target, 3 sec. The validity of the beat map and period with the rim is verified by comparing to the one of the King Seong-deok Divine Bell. This study explains the reason why the clear and unclear beats periodically positioned along the circumference of the rim. And it shows the cause why the impact position and direction govern the characteristics of beat sound. Based on this study, even a smaller ring structure can make the beat sound with an optimized section shape.

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