

ACOUSTIC EVALUATION OF 'DEAD-SPOTS' IN INDOOR SPORTS SURFACES

Dr. P. W. Elliott
The Robbins Institute, Cincinnati, Ohio, USA

INTRODUCTION

End-users of indoor sports surfaces often report the presence of 'dead-spots.' Athletes perceive 'dead-spots' as points producing ball rebound height significantly below the rest of the sport surface. Subjective and quantitative analysis of dead-spots often disagree when measurements are based on the rebound height that is generated on these points. One reason for this disagreement is that the subject is receiving information from several sources including sound and vibrations. Most subjects can not separate out the actual rebound height from the false signals that are being received. This study looks at new methods to characterize 'dead-spots' that better correlate with the subjective evaluations.

METHODS

A group evaluated a sports-surface for 'dead-spots'. The group was comprised of a high-school basketball coach and participants in a physical education class. More than 50 'dead-spots' were identified on the playing surface. Twenty points were randomly selected from the group of 'dead-spots' to be evaluated for their rebound characteristics. Five additional reference points were chosen to represent performance that the group felt was satisfactory. The measurements and evaluation were made according to the procedures outlined in the DIN standard 18032 with one exception. This exception was that the basis was switched from the rebound height obtained on concrete to the rebound height on a portion of the floor that was considered acceptable. Ball rebound height was calculated using the time between impacts and projectile physics. The ball reflection of each point was calculated using the following equation:

$$BR\% = \frac{h_{point}}{h_{reference}} \cdot 100$$

The sound generated during the impacts was recorded using a laptop with a standard personal computer microphone. The sound files were used to examine the sound quality of the various points tested.

RESULTS

The results showed that five of the twenty points labeled 'dead-spots' using subjective evaluation produced ball reflection values greater than 100%. Examining the rebound height alone, these points appeared to be identical to those selected as base or reference points. The difference between the recorded

sounds was evaluated by using the power spectral density, or PSD, of the sound generated during the first impact between the ball and the playing surface. The PSD of the sound produced from the reference points and from the 'dead-spots' is shown in Figure 1. Figure 1 shows that there was a significant difference between the sound produced by the reference points and the points identified as 'dead-spots.' The trend shown in Figure 1 continued well beyond 2000 Hz.

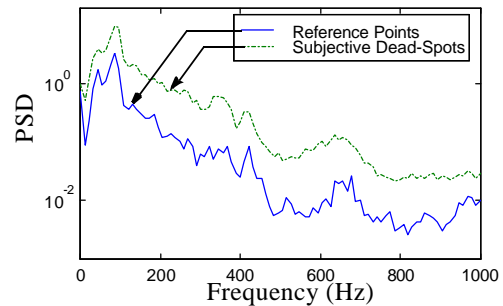


Figure 1: PSD of the sound produced on reference points and 'dead-spots'.

The sound produced from the five false readings were then compared to the base points. This produced results graphically similar to those presented in Figure 1. The results of this comparison suggest that an athlete's perception of rebound height is effected by the sound produced during the impact. It also suggests that the 'dead-spot' phenomena may be more closely related to acoustic differences rather than actual differences in rebound height.

DISCUSSION

This study suggests that subjective measurements of 'dead-spots' involve the effects of variables above and beyond simple rebound height. This study found that there appears to be a stronger relationship between the sound produced during impact and subjective 'dead-spot' evaluation rebound height and subject evaluations. Strengthening this relationship will require further research, but could ultimately provide a more accurate way of quantitatively evaluating 'dead-spots'. This would provide a more rigorous definition of what a 'dead-spot' is, and would allow sports surface designers to design floors that are less prone to developing 'dead-spots.'

REFERENCES

1991, DIN Standard 18032: Requirements for Sports Floors in Sports Halls and Gymnasiums.