

# A Study on Skill of Meat Cutting Using Accelerometer

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## Abstract

We carried out a series of experiments and measured actions for cutting meat using accelerometers in order to examine the skill of cutting meat. We noticed that the difference between skilled workers and beginners is in the rhythm of their movements. Beginners did not show the rhythm because of their excessive movements in one action for cutting meat. Skilled workers showed the stable movements which did not involve excessive ones. Therefore, they exhibited the rhythm.

## Introduction

It is important to transfer knowledge in the knowledge society. We are interested in skills as a sort of tacit knowledge and hope to establish a theory of skill transfer.

In this paper, we aim to answer to the following questions. Firstly, what is skill for cutting meat? Secondly, what is the difference between skilled workers and beginners?

In order to answer the questions, we carried out a series of experiments and measured actions of meat cutting using accelerometers at the meat section of a supermarket.

## Experimental Details

Participants were post-graduate students at our institute and supermarket workers. In the experiments, we regarded the students as beginner and supermarket workers as skilled worker. All supermarket workers have worked at the supermarket at least for eight years.

Participants were asked to make the following two products: pork cutlet and sliced pork. Participants had to use a knife to make pork cutlet and a slicing machine to make sliced pork. Figure 1 shows pictures of pork cutlet and Figure 2 pictures of sliced pork.

Three accelerometers were put on them as follows. For the experiments of pork cutlet, we paid our attention to the movement of right hand, that is, the dominant hand holding a knife. The accelerometers were installed on the back of right hand, the right elbow and the lumbar. For the experiments of sliced pork, we paid attention to the movement of left hand. The accelerometers were installed on the back of left hand, the left elbow and the lumbar because the participants picked up the sliced pork with left hand.

We have already carried out five experiments, for which we employed five skilled workers and five beginners. Each participant performed the tasks three times.

## Results

We examined the movement of the right hand and lumbar as for the experiments of pork cutlet. Figure 3 shows a begin-

ner's movement and Figure 4 shows a skilled worker's movement while cutting pork cutlet.

In one action of meat cutting, the beginner's movement of his lumbar is synchronized with his right hand's movement. On the other hand, the skilled worker's movement of his lumbar is not synchronized with his right hand's movement. The beginner moved the knife five or six times to cut a piece of meat. The beginner's movement is excessive because two or three moves are enough to cut a piece. The skilled worker cut in fact a piece of meat by moving the knife two or three times.

In cutting the meat, the beginner shows a random movement at hand due to his excessive movement, while the skilled worker shows a stable movement.

For the experiments of sliced pork, we investigated the movement of left hand. Figure 5 shows the beginner's movement and Figure 6 shows the skilled worker's movement while making slices of pork.

In one action of picking up a slice of meat, the beginner does not move his left hand regularly, while the skilled worker moves his left hand up and down. The beginner shows excessive movements in making slices of pork. The skilled worker does not show such excessive movements.

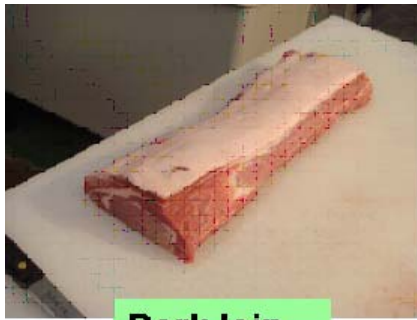
In cutting meat, the beginner's movements are not regular due to his excessive movements, while skilled worker's movements are stable.

## Analysis

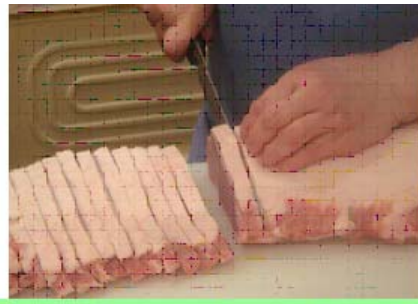
We noticed that the difference between skilled workers and beginners is in the rhythm of movement. The rhythm can be defined as the similarity of movements between one action and another action in the meat cutting.

It is important to cut meat with the knife pushing two or three times while cutting meat to make a piece of pork cutlet. Both skilled workers and beginners pushed the knife to cut meat. However, beginners did not use the knife from tip to end. Figure 3 shows that the movements of right hand and lumbar are both excessive in one action for cutting meat. As the result, their movements are irregular. The beginner's movement is thus not rhythmical. We found that all beginners' movements are irregular due to their excessive movements, therefore, beginners' movements were not rhythmical while cutting meat.

Skilled workers, on the other hand, used the knife from tip to end. Figure 4 shows that the skilled worker moves the knife three times to cut a piece of pork cutlet. The skilled worker's movements are not excessive in one action for cutting meat. As the result, his movements are regular while cutting meat. Therefore, the skilled worker's movement is rhythmical. We found that all skilled workers did not show excessive movements, therefore, skilled workers' movements were rhythmical while cutting meat. Each skilled worker showed a



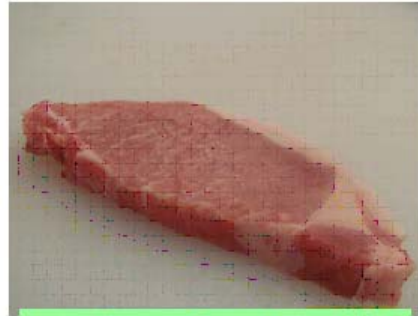
**Pork loin**



**While cutting a piece of pork cutlet**



**pork cutlet**



**a piece of pork cutlet**

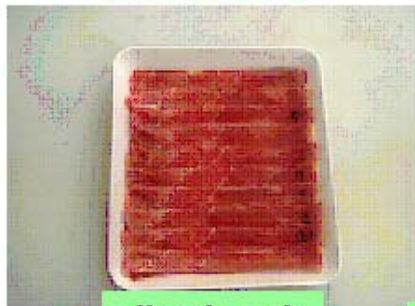
Figure 1: Pork Cutlet



**pork ham**



**in catching a piece of sliced pork**



**sliced pork**



**while making a piece of sliced pork**

Figure 2: Sliced Pork

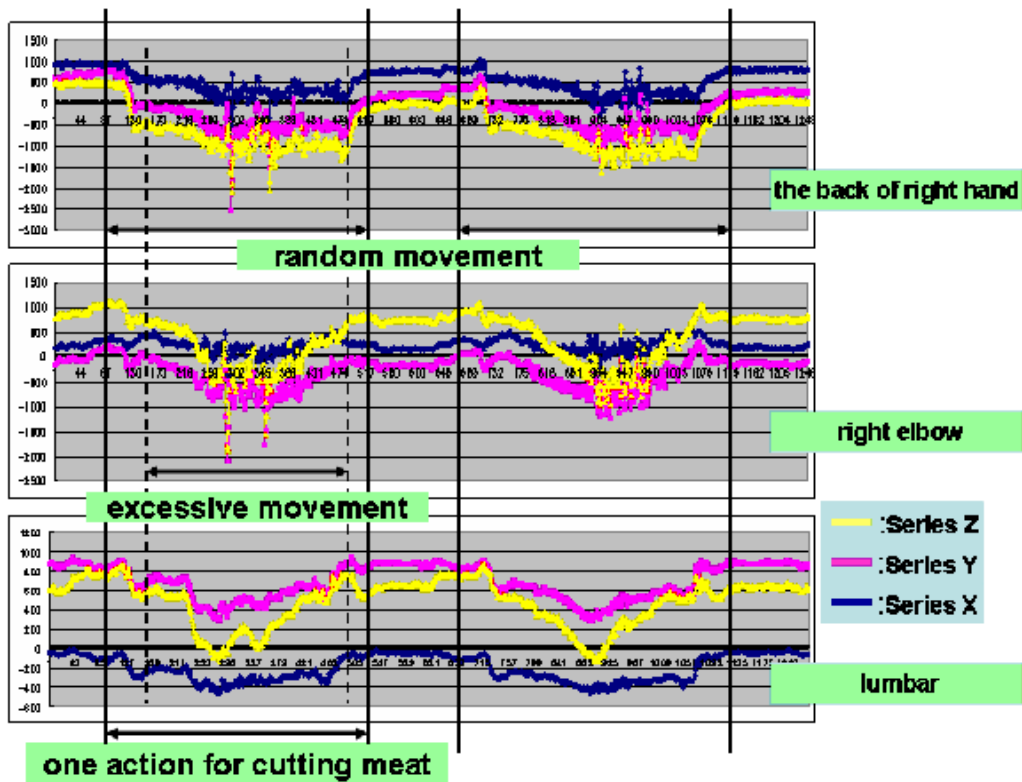


Figure 3: Beginner's Movement While Cutting Pork Cutlet

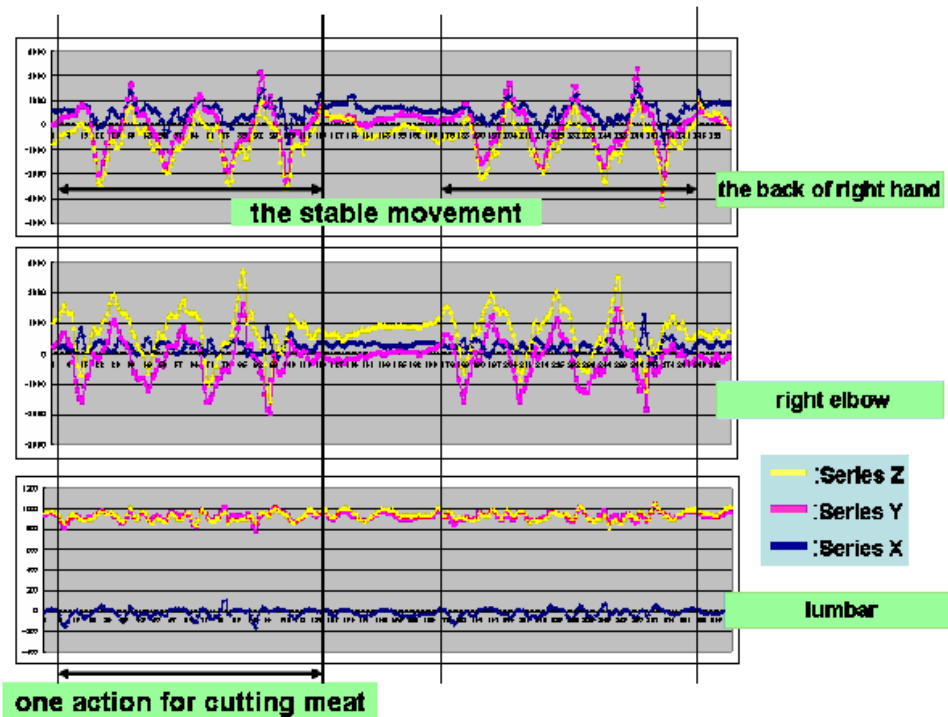


Figure 4: Skilled Worker's Movement While Cutting Pork Cutlet

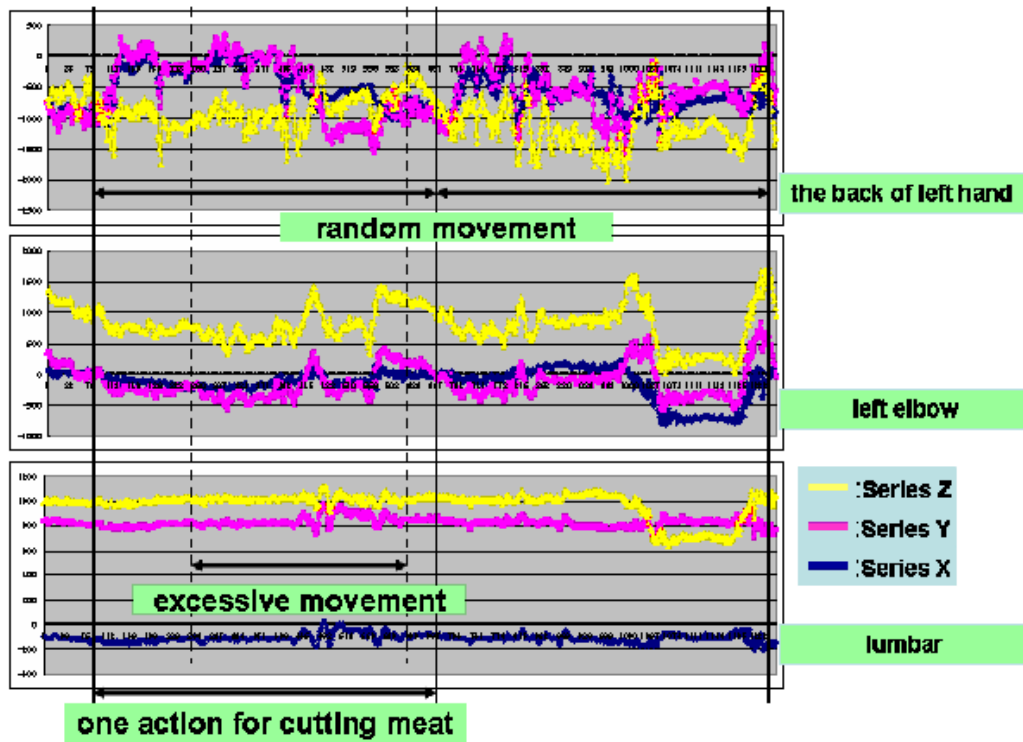


Figure 5: Beginner's Movement While Making Sliced Pork

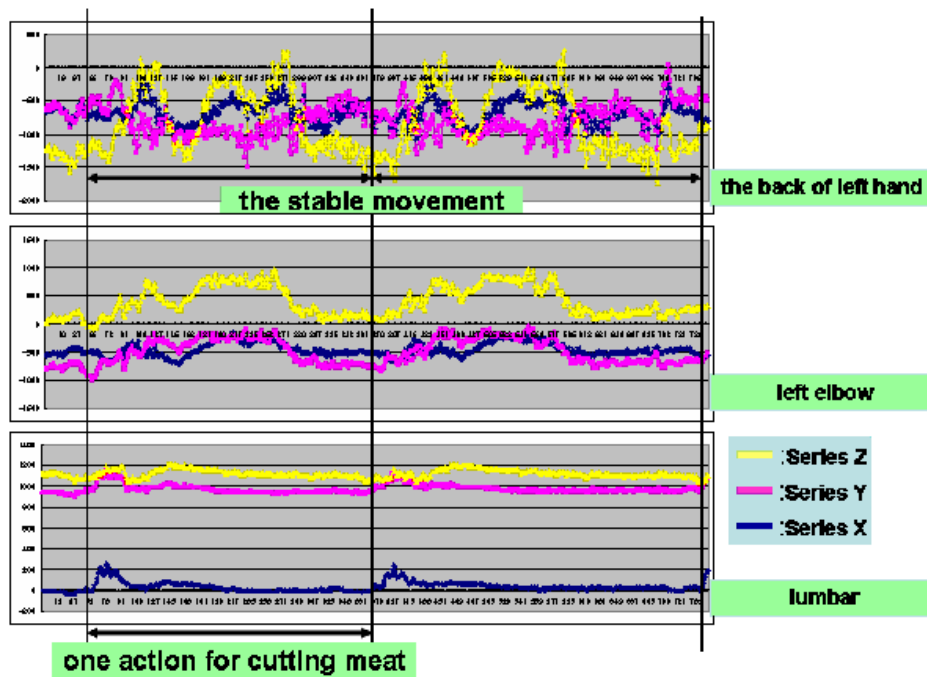


Figure 6: Skilled Worker's Movement While Making Sliced Pork

stable movement peculiar to the person.

While making slices of pork, it is important to catch a piece of sliced meat as the preparatory movement in order to set it on the plate rapidly so that pieces are set in order. Beginners caught a piece of sliced meat, but they did not catch it without folding it. As the result, they showed the excessive movements to spread it. They showed the random movement while making sliced pork because of their excessive movements in one action of meat cutting. Therefore, their movements did not exhibit the rhythm.

Skilled workers, on the other hand, showed the left hand's movement of up and down. They caught a piece of sliced meat spread to set it on the plate rapidly. There was not excessive movement. As the result, their movement was stable while making sliced pork. Their movement showed, therefore, a rhythm in the series of the left hand's movement.

It was not proved whether any skilled workers show a rhythm. However, it was proved that if a person is a skilled worker, he shows a rhythm. Through our experiments, each skilled worker had a peculiar movement, in other words, they showed a distinctive rhythms.

## Conclusion

We carried out a series of experiments and measured actions for cutting meat using accelerometers in order to examine the skill of cutting meat. We noticed that the difference between skilled workers and beginners is in the rhythm of their movements.

Beginners did not show the rhythm because of their excessive movements in one action for cutting meat. Skilled workers showed the stable movements which did not involve excessive ones. Therefore, they exhibited the rhythm.

We are aware of two problems. Firstly, we have to analyze collected data. In the viewpoint of cutting rhythm, we will analyze the data with autocorrelation and grade their skills based on a standard. Furthermore, we will clarify the difference between skilled workers and beginners by inventing an evaluation method of skills. Finally, we hope to establish an environment of skill transfer enabling effective and efficient learning.

## Acknowledgement

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