

# APPLICATION OF MOIRÉ METHOD FOR ANTHROPOMETRICAL ANALYSIS

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## SUMMARY

*In this article the authors are presenting a new method for anthropometrical analysis, the results of which they want to apply to the development of a 3D modelling system in the apparel industry. They analyse the provided possibilities and the limitations of the optical principle based-on moiré method from the measuring technique point of view.*

## 1. INTRODUCTION

The most modern methods for measuring the spacial figure of bodies are provided by optics. The real advantage of these measurements lies in the fact that they are touch-free, that is the measured object is not burdened by measuring-pressure, furthermore they are synchronic. In anthropometrical analysis both of these aspects are extremely important, because in the case of human body analysis the deformation arising from measuring-pressure is the source of serious error possibility, furthermore the synchronism plays a serious role, as in order to ensure the immobilization of the body for a prolonged time it can stumble over serious difficulties.

One of these measuring methods is the moiré method, through which the measures can be deduced from the moiré stripes specific to the examined surface.

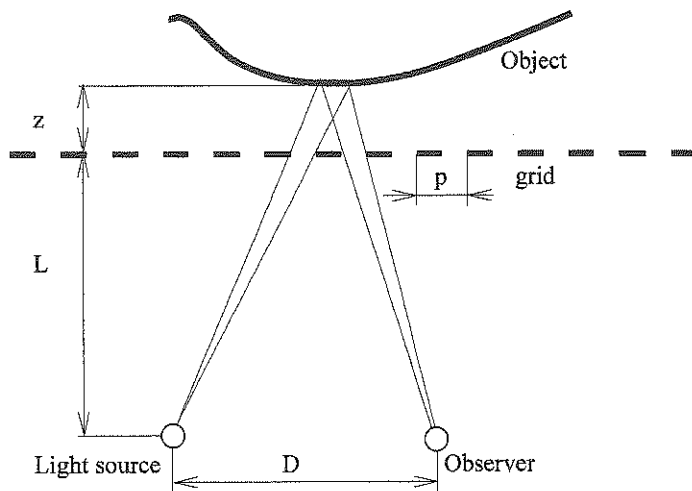


Fig. 1. The scheme of shadow moiré

In front of the analysed body, owner of favourable surface reflection characteristics is placed a transparent umbrella with equidistant striping. The wave-fronts emerging from the pointful light-source and crossing the umbrella create a shadow on the analysed surface. Due to shading the parameter (period-length) of the striping obtained on the surface is modified depending on the body figure, thus for the visual observer (in this case camera or other recording device) placed deviated from the light-source, two stripes appear (one is the shadow appeared on the body, the other is the stripe placed on the umbrella), which interacting originate an interference-type moiré effect TAKASAKI [1] YOSHIKAWA [2] WENZEL [3]. Based on geometrical optical considerations it is certifiable that the originated stripes of the moiré effect describe the surface similarly to the contour-lines of maps. Thus, after identifying the stripes, all three coordinates of the surface points of the body can unequivocally be given in a pre-chosen reference system and can be applicable to further data processing.

## 2. THE MEASURING RANGE

The application of moiré effect makes possible the three dimensional measuring. The measuring range of the equipment is that part of the analysed surface where the effect appears. The appearance of moiré stripes strongly depends on:

- the optical quality of the surface,
- the shape of the surface,
- the environmental light conditions,
- and the geometrical parameters.

In the case of applying the moiré method, the direct knowledge of geometrical parameters is indispensable for the determination of exact information of the analysed surface. The necessary geometrical measures are:

- the distance between the light-source and the analysed unit,
- the spacial frequency of the analysed grid,
- the distance between the light-source and the analysed grid,
- the distance between the analysed unit and the analysed grid.

Furthermore, the knowledge of an arbitrary range of moiré stripes appeared on the surface is indispensable, in order that the three dimensional co-ordinates of arbitrary surface points can be determinable with the pursuance of constantly recognizable and identifiable moiré stripes.

## 3 THE MEASURING PRECISION OF THE EQUIPMENT

The two co-ordinates of the analysed surface points from the moiré projection plane can be directly readout after determining the amplification of the projection. The third co-ordinate, the depth measure is the co-ordinate held by the moiré projection as indirect information, which can be readout from the moiré stripes. The depth variation between the two adjacent moiré stripes is the function of geometrical parameters and stripe range. This means that the analysed surface is defined by the intersection lines of the moiré projection between the projection plane and parallel planes, having determinable intervals on the surface. In other words, the depth measure of the surface points of one moiré stripe is identical, similarly to the contour-lines of maps.

The determination possibility of the measuring precision perpendicular to the projection, in this case the interval between two intersection planes is the function of geometrical parameters, and based on experimental data it corresponds to the value expected in anthropometrical analysis.

The computerized ratability of moiré projections necessitates digital recording and registration. The limited resolution of digital projection recorders does not represent an impediment for the recording of moiré stripes, because the spacial frequency of the moiré stripes carrying useful information is substantially smaller than the spacial frequency of the shadow appeared on the surface, insignificant from the measuring point of view, on the effect of the analysed grid.

#### 4. EXPERIENTIAL PRACTICE

The experiments conducted with an experimental equipment constructed at the Department of Polymer Engineering and Textile Technology of Budapest University of Technology and Economics are very propitious and encouraging.

The practice shows that for the exact estimation of moiré stripes the surface has to be light coloured and diffusingly reflectable. For its benefit we have prepared special, skin-tight clothes for the persons to be analysed, from a hite fabric with mat surface and great elasticity.

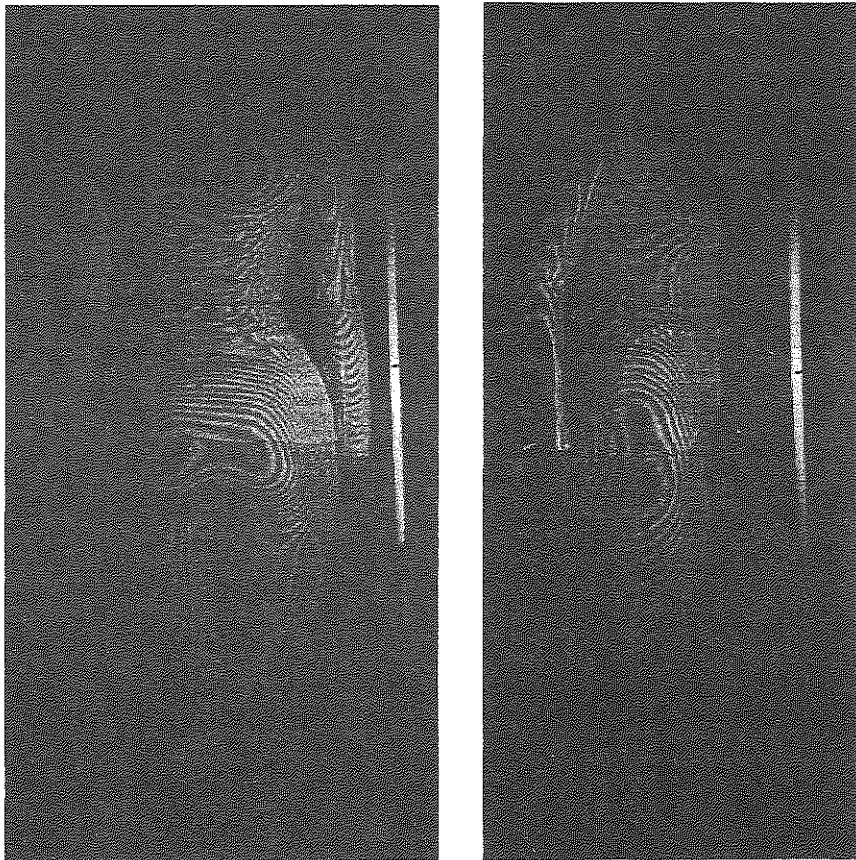


Fig. 2.  
Experimental moiré recordings

For the origination of an adequate quality moiré effect it is necessary that during the recording we eliminate the influence of all other light-sources, that is why we conducted our experiments in a totally darkened room.

In order to help on the anthropometrical evaluation we set reference points on the special clothes of the analysed person in accordance with the important body points from the anthropometrical point of view. Besides this, during the moiré projection recording we placed a standard metric near the analysed person for the ulterior evaluation of the amplification scale.

A recording prepared with the equipment is shown in Fig. 2. It is noticeable that the moiré stripes thicken on the surface parts with great steepness implied from the shape of the surface, but the augmentation of the measuring indefinitude which arises from this is reducible with the help of recordings made from a different angle and interadaptable.

From the anthropometrical point of view, with the evaluation of moiré recordings all required information is disposable for the development of 3D modelling system in the apparel industry, and through this for the generation of the analysed person's 3D body model and for the designing of made-to-measure clothes.

#### Acknowledgments

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