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# Role of Mathematics in Sports Sciences and Technologies

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With the competitive and the commercial nature of sports, as a means to promote international coöperation, collaboration and manage conflicts, the nations, having superiority in sciences and technologies, are investing in sports and health sciences and technologies. Mathematics plays a vital role in developing and improving sports activities. This paper discussed 3 areas of application (*sports medicine*, *kinesiology* and *sports-performance analysis*), for which the infrastructure, the facilities and the human resources are available at University of Karachi, and students are engaged in graduate course work and research. In the area of *sports medicine*, our group has developed indigenous instruments and methods for measurement of height, weight, mid-upper-arm circumference and shoulder width, employing ideas from mathematics, physics and civil engineering, with mathematical and statistical models for reliability of data. To test these instruments and techniques, our team collected data on over 2500 children between the ages of 5-11 years. Our height-measurement system was adapted by Tawana Pakistan team. Using techniques of numerical analysis, methods were developed to generate detailed growth profile of an athletic child, indicating stunting and wasting/obesity as well as a prediction of adult height and weight, which became very important, when one selected athletes to train them as basketball players, wrestlers or gymnasts. Skeletal examination of school athlete, with a focus on detection of trunk deformities, in particular scoliosis, must be mandatory in the age range 9-11 years. In the Syed Firdous Growth and Imaging Laboratory a light-weight, full body moiré fringe topography set-up, developed locally, is being used to screen for trunk deformities (scoliosis, kyphosis and lordosis). The author has developed methods to determine Cobb angle from measurements performed on moiré topographs (and its generalization in 3-D, the Asr Angle). Heart-size and condition was determined, without expensive monitoring equipment, using geometric model of heart put forward by author in 2002. In the area of *kinesiology*, moiré fringe topography and rasterstereography were used to study postures and gaits of athletes. Moiré fringe topography and rasterstereography are (non-contact and non-invasive) stereophotogrammteric techniques, which provide 3-D information in terms of height and curvature maps of the study surface. These techniques do not involve ionizing radiations, *e. g.*, X rays, posing no risk to althletes. In the context of 3-D-static model of the human spinal column (put forward by author in 1982, complete version published in 1996), profile of spinal column in three dimensions was generated by moiré photograph of back. A simultaneous recording from moiré and raster gave height and curvature maps of spinal column (thus generating 3-D profile of spinal column) in each phase of human gait (technique developed in 1996). A 3-D-dynamic model related spinal column in each phase to the next through edge-based algorithm. Edge-based moiré and edge-based raster allowed study of changes in height and curvature maps of human back during a gait cycle. In the area of *sports-performance analysis*, unwanted motion in the sagittal plane by a gymnast performing on vault may be monitored using edge-based moiré. There is a need for planning and implementing dynamical and robust *Sports Sciences and Technologies Programs* in national universities and sports-training institutions, in place of the traditional *Departments of Health and Physical Education*. This is the only way for Pakistan to regain glory in hockey and cricket and follow a path leading to excellence in other events, *e. g.*, gymnastics, swimming, hockey, boxing, football, running and athletics.

**Measurement of height and mass of a boy in SF-Growth-and-Imaging Laboratory**

*Keywords***:** Height, weight, posture, gait, cardiac fitness, scoliosis, moiré fringe topography, rasterstereography, gymnastic performance

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