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# 3-D-Dynamic Modeling of the Human Spinal Column

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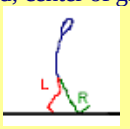
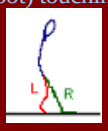
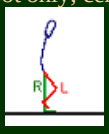
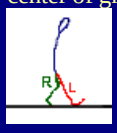
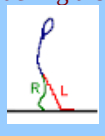
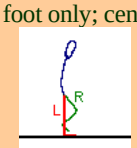
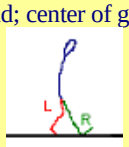
This model, a generalization of 3-D static model developed earlier, included movement of the human spinal column during a gait cycle (Table 1). The human spinal column in three dimensions was generated from moiré topographs of back in the anatomical position as well as during the first, the second, the third and the fourth phases of gait cycle. Spinal column in the anatomical position was subsequently linked to position during the first phase of gait cycle through the edge-based algorithm. Similarly, position in the second phase was linked to the first phase through the edge-based algorithm and so on. Apart from the medical sciences where this model could be utilized in the study of the human gait one may apply this model in space medicine where physiology of the human spine could be studied in subdued gravity, *e. g.*, during prolonged stay in space stations.

**Table 1. Phases of normal gait of a child**

| | *Right Leg* | | *Left Leg* |
|---|---|---|---|
| **Phase 1:** Right leg forward, left toe and right heel touching the ground; center of gravity lying between the two feet | | | |
| *Hip* | Extension |  | Extension |
| *Knee* | Extension | | Extension |
| *Ankle* | Dorsiflexion | | Planter Flexion |
| **Mirror Image of Phase 4; identical to Phase 7** | | | |
| **Phase 2:** Right leg forward, right toe and right heel (that is, the right foot) touching the ground as well as left toe on ground | | | |
| *Hip* | Extension |  | Extension |
| *Knee* | Flexion | | Flexion |
| *Ankle* | Neutral | | Neutral |
| **Mirror Image of Phase 5** | | | |
| **Phase 3:** Left foot in air (moving forward), body supported by right foot only; center of gravity lying on top of right foot | | | |
| *Hip* | Flexion |  | Flexion |
| *Knee* | Flexion | | Flexion |
| *Ankle* | Neutral | | Neutral |
| **Mirror Image of Phase 6** | | | |
| **Phase 4:** Left leg forward, right toe and left heel touching the ground; center of gravity lying between the two feet | | | |
| *Hip* | Extension |  | Extension |
| *Knee* | Extension | | Extension |
| *Ankle* | Planter Flexion | | Dorsiflexion |
| **Mirror Image of Phase 1** | | | |
| **Phase 5:** Left leg forward, left toe and left heel (that is, the left foot) touching the ground as well as right toe on ground | | | |
| *Hip* | Extension |  | Extension |
| *Knee* | Flexion | | Flexion |
| *Ankle* | Neutral | | Neutral |
| **Mirror Image of Phase 2** | | | |
| **Phase 6:** Right foot in air (moving forward), body supported by left foot only; center of gravity lying on top of left foot | | | |
| *Hip* | Flexion |  | Flexion |
| *Knee* | Flexion | | Flexion |
| *Ankle* | Neutral | | Neutral |
| **Mirror Image of Phase 3** | | | |
| **Phase 7:** Right leg forward, left toe and right heel touching the ground; center of gravity lying between the two feet | | | |
| *Hip* | Extension |  | Extension |
| *Knee* | Extension | | Extension |
| *Ankle* | Dorsiflexion | | Planter Flexion |
| **Identical to Phase 1** | | | |

*Keywords***:** Edge-based algorithm • Gait analysis • Moiré fringe topography • Stereophotogrammetry

*Web address of this document***:** https://www.ngds-ku.org/Presentations/Dynamical.pdf