Reducing Road Traffic Casualties through Improved Forensic Techniques and Vehicle Design (RoaD) - PROOF OF CONCEPT

The RoaD pilot study investigated the technical feasibility of creating a unique Pedestrian Trauma Database (PTD). The PTD has the potential to contribute to understanding a pedestrian's injury assessment and support on-the-spot triage, forensic investigations and grieving families by limiting the use of standard post-mortem (PM). A mathematical model, based on physics and using virtual collisions, was created to validate the potential of a PTD (Figure 1) as well as its future implementation.

Figure 1: Typical Vehicle to Pedestrian Collision Computer Model [1]

In its simplest form, during an impact, the human body organs are stretched and then tear. Trauma is caused when the power exerted on organ tissues exceeds their capacity to resist damage, leading the organ structure to be more random, i.e. less ordered (Figure 2).

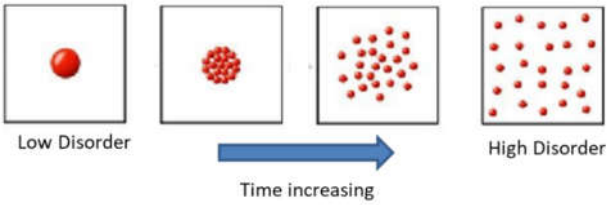

Figure 2: Organ disorder after an impact

This phenomena can be captured by using the concept of "entropy" (second law of thermodynamics), which relates to inefficiency, degeneration and decay. This concept is universally accepted and used amongst other scientific applications, like cosmology and quantum mechanics [2]. This entropy approach to trauma injury modelling is innovative and is an improvement from the current methods available in biomechanics [3][4][5]. These current methods use organ maximum stretch and maximum pressure as means to estimate the state of damage, however they do not take into account how injury severity increases with speed [4]. It is the maximum power exerted on an organ during the collision event, which dictates its injury severity: the higher the power, the more serious the injury [4]. Injury severity is coded against the Arbitrary Injury Scale (AIS) ordinate scale [6], which represents the threat to life (Table 1).

AIS Level	Injury	Risk of death %
1	Minor	0.0
2	Moderate	0.1 -0.4
3	Serious	0.8 – 2.1
4	Severe	7.9 – 10.6
5	Critical	53.1 – 58.4
6	Untreatable	100

Table 1: Relationship between AIS and risk to life [6]

The trauma computer model in this pilot study, matched the AIS observed for the five datasets available. The RoaD pilot study therefore concluded that, using this new mathematical trauma method, a PTD of the brain trauma severity and location (Figure 3) was feasible [9] and that, in the future, this method could be extended to the liver, spleen, kidneys and heart.

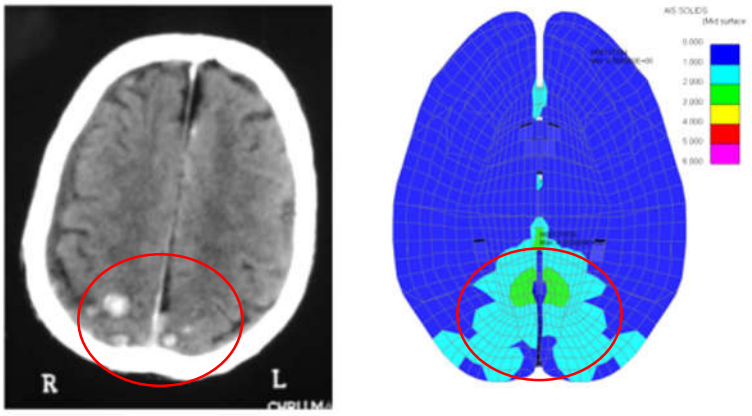

Figure 3: Human brain slice: CT-Scan (Left) vs Computer Model (Right). Location (Circle) and AIS severity (0: blue (no injury) to 6: purple (untreatable)) [8]

This brain white and grey matter mathematical trauma model devised in the RoaD project will be made available worldwide as part of the Total Human Model for Safety (THUMS) human model suite from spring 2021 [10].

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