

## Modeling of Wound Healing: The Proliferation and Maturation Stage

Amanda Patrick

Benito Chen-Charpentier

Department of Mathematics, University of Texas at Arlington

### Abstract

A wound is caused when the integrity of living tissue in the body is compromised. The body repairs a wound in overlapping stages, namely, homeostasis, inflammation, proliferation, and remodeling. As soon as the wound happens blood clots to stop the bleeding. bleeding stops. Next, the inflammatory system removes pathogens and debris. In this talk we deal with the formation of the provisional matrix in the proliferation and maturation stage. This matrix is fundamental so that new tissue can be built and problems in its formation are a leading cause of wounds not healing. The model is based on a system of six ordinary differential equations involving a cytokine, the matrix metalloproteinases (MMPs), myofibroblasts, fibroblasts and two types of collagens. It is constructed using assumptions and parameter values from the medical literature. Numerical simulations are presented. Since the model involves a large number of parameters which are hard to measure or estimate, a global sensitivity analysis is performed to determine which parameters cause the largest variations in the solutions, and therefore need to be measured with more care. The sensitivity analysis is performed using FAST which is a global analysis of variance method which is relatively fast. Also, since the reported data has large variations due to natural differences in individuals, experimental methods and even errors, the variables are then assumed to be stochastic and a system of stochastic differential equations is introduced and solved numerically using the Milstein method and thousands of realizations performed. The models can help test hypothesis about the different species active and their interaction and importance. It is especially important to establish how to speed the time of healing of a wound, and what are the possible causes of a wound not healing. The models will help medical doctors and experimenters improve wound care and help determine causes of diseases.