

Development and Mathematical Analysis of a Space-Dependent Model for the Spread of Ebola

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The Ebola virus causes an acute, serious illness, which is often fatal if untreated. Thus, it is important to give an epidemic model that considers not only the spread of the disease, but also a feasible delivery system, the speed of producing the vaccine, a drug for Ebola or the effect of the migration so that we can optimize the eradication of the virus. In mathematical epidemic modeling many structures exist for the disease spreading. In this work we are going to develop a model to describe the dynamic of the virus in space and time and for this purpose the extended version of the SEIRS epidemic spread model is used in combination with extra carriers and other groups.

We give a short introduction into the mathematical and numerical theory of general time-dependent epidemic spread models in form of ordinary differential equations. Then our aim is to extend this model by different influential factors, such as the population migration. This modification introduces space dependence into the system and transforms it into the form of partial differential equation (PDE). One way to combine the original system with the migration model is the operator splitting method, which allows us to solve the extra operators connected to each other by the appropriate initial conditions independently from the basic model. In the enlargement of the subject we show the way to develop the dimensionless form of the PDE based on real measured data collected by the World Health Organisation (WHO).

Finally, we apply the sequential splitting method based on the classical explicit Euler scheme for the numerical analysis in order to predict the morphosis of the disease spreading and to give some preventative or amending suggestions.