Drill strings used in oil and gas operations are long circular columns approximately 3 to 5km long, 30 to 50cm in diameter while surgical threads are typically 75cm to 1m long and 0.5 to 1mm thick, depending on the type of surgery, so both share the characteristic of having a diameter to length ratio on the order of 10^-3. Drill string operators need to constantly monitor the position of the drilling apparatus as excessive vibrations can lead to sudden equipment failure. Likewise, a surgeon would want to avoid thread tangling, a non-linear and dynamical process particularly detrimental during knot formation.

The elementary Euler-Bernoulli, or even the Timoshenko beam theory, are insufficient to predict the correct configuration of the structures which will coil, i.e. twist around their own axis in addition to bend and twist. Instead, we will use finite element computational tools using the lesser-known Cosserat theory of rods.

In the case of surgical thread, the goal of our research program is the development of software that will be used by medical school students to practice the task of surgical suturing so the program’s immediate benefits are pedagogical and also in line with the Qatar Sidra project to offer state of the art medical training.

In the case of drill string dynamics, the objective of our program is to understand the interactions between the vibration sources and drill string-BHA (bottom hole assembly) responses and to offer “real time” assistance to drilling rig operators by developing advanced dynamics simulation software. With such high associated operational costs, the anticipated benefits of the program are clearly economical.

By engaging simultaneously in these two research programs, we hope to demonstrate that the Cosserat rod theory is a powerful tool that can be used to solve a wide range of applications that may otherwise appear very distant.