Deoxyribonucleic acid (DNA) is constructed from two linear, parallel, inconceivably long and heavily supercoiled helical polymers, commonly referred to as the double helix Watson-Crick model after the two Nobel laureates, James Watson and Francis Crick. DNA is not motionless. It constantly wriggles in a medium of organic fluid in the nucleus of a cell. From an engineering's viewpoint, DNA can be modelled as a double twisted helicoidal structure constantly interacting with surrounding organic fluid. This research aims at extending, utilising and generalising the research team's expertise in nonlinear dynamics of (i) fan blades and spiral/drilling structures, and (ii) viscous, low speed fluid to biomechanical DNA fluid-structure interaction. Employing a nonlinear helicoidal model, the energy stored in a distorted Watson-Crick DNA model subjected to viscous, low speed organic fluid loading can be examined. An efficient recursive numerical scheme based on the variational principle has been developed.

The chemical structure of everyone's DNA is the same. The only difference between people (or any animal) is the order of the base pairs. There are so many millions of base pairs in each person's DNA that every person has a different sequence. Using these sequences, every person could be identified solely by the sequence of their base pairs. However, because there are so many millions of base pairs, the task would be very time-consuming. Instead, scientists are able to use a shorter method, because of repeating patterns in DNA. These patterns do not, however, give an individual "fingerprint," but they are able to determine whether two DNA samples are from the same person, related people, or non-related people. Scientists use a small number of sequences of DNA that are known to vary among individuals a great deal, and analyze those to get a certain probability of a match. In this research, significant dynamical responses such as energy distribution, bending and twisting of DNA model under organic fluid excitations can be analysed. Matching of DNA sequential characteristics with respect to the dynamical responses can be derived in order to reveal information regarding DNA sequencing by means of a fluid-structure dynamical approach.

Figs. 1 and 2. Elementary DNA molecular and structural models

Figs. 3. A helix

Fig. 4. A helicoidal structure

Fig. 5. A helicoil

Colour indication
grey : carbon
white : hydrogen
red : oxygen
blue : nitrogen
orange : phosphorus

thickness not shown, but included as \( h \) (can be a variable) in formulation
Traditionally, Chinese physicians use fingertips to "feel" the wrist pulses of patients in order to determine the health conditions of patients. The qualitative theory of the wrist-pulse diagnosis is based on the experience of Chinese doctors for thousands of years. Traditional Chinese physicians use palpation to differentiate 31 pulse patterns at three spatial locations (inch, gate, and foot) and three depth locations (superficial, middle, and deep) on the left and right wrists in terms of the following 11 pulse categories.

1. Depth: floating or deep (a floating pulse is found in the upper region of a pulse position while a deep pulse is found in the bottom region);
2. Intensity: strong or weak (a strong pulse refers to a forceful beat while a weak pulse refers to a delicate beat);
3. Amplitude: big or small (a big pulse refers to a large stroke while a small pulse refers to a short stroke);
4. Frequency: fast or slow (a fast pulse refers to frequent beats while a slow pulse refers to infrequent beats);
5. Rhythm: rhythmic or arrhythmic (a rhythmic pulse refers to uniform cycles of the pulse while an arrhythmic pulse refers to irregular cycles);
6. Length: long or short (a long pulse has a wide base while a short pulse has a thin base);
7. Type: yang or yin (a yang pulse is characterized by an expanded pulse while a yin pulse is characterized by a deflated pulse);
8. Temperature: hot or cold (a hot pulse is associated with an energetic pulse rate while a cold pulse is associated with a lethargic pulse rate);
9. Quantity: shih or cold (a shih pulse contains a large amount of energy while a cold pulse contains a small amount of energy);
10. Texture: hard or soft (a hard pulse is characterized by a pointed top while a soft pulse is characterized by a round top);
11. Width: wide or thin (a wide pulse has a large peak while a thin pulse has a narrow peak).

However, there are no quantitative mathematical theories to relate these different pulse states to the health conditions of patients. This is a research in a new innovative subject dealing with automated Chinese pulse diagnosis. The aim is to design a non-invasive device for measuring wrist-pulse continuously and to analyse the wrist-pulse waveforms captured digitally by the designed device based on the newly developed Hilbert spectral analysis method.

An electronic pulse-taking device can be developed based on the sphygmomanometric technique. Wrist-pulse waveforms can be captured and digitized by the designed device and written to disk as a computer file. Each wrist-pulse waveform can then be matched with one of the 31 recognized wrist-pulse patterns in traditional Chinese medicine using the newly developed Hilbert spectral analysis method. The fact that an electronic device is interfaced with a personal computer holds open the possibility that an automated system of interpreting wrist-pulse patterns (according to the 31 recognized wrist-pulse waveforms in traditional Chinese medicine) could be developed.

Fig. The Cun, Guan and Chi positions