Abstract: Magnetic tunneling junction (MTJ) sensors are finding ever more diverse applications. One such area is the detection of slow-moving fluids in medical catheters. Drainage of cerebral spinal fluid is important in the treatment of hydrocephalus, which has an incidence rate of 5.5 per 100,000. A common failure mode of implanted cerebrospinal fluid shunts is occlusion or fouling of the catheter which occurs in 40% of the implanted shunts during the first year, in 50% by the end of the first two years and as high as 80% during the lifetime of the implant. Today around 10% of deaths related to hydrocephalus are caused by shunt failure, despite significant advances in shunt design. The height failure rate leads to over 27,000 surgeries every year that are aimed to repair or diagnose a failing shunt. This presentation describes the development of a highly sensitive microfluidics flow sensor using MTJ magnetic sensors to detect motion of slow-moving fluids. A motivating application for the proposed device is the development of an implantable flow sensor, capable of monitoring the amount of cerebral spinal fluid drained from the ventricles of the brain. Micro-fabricated ferromagnetic flaps are used to detect motion of the surrounding fluid. The deflection of the flaps is detected by an ultra-sensitive MTJ magnetic field sensor placed outside of the lumen of the catheter. Numerical design methods and experimental evaluation will be described resulting in a flow measurement range of 1-50 ml/h with a resolution of 0.4 ml/h and an uncertainty of 4% RMS. Temperature related signal drift will also be addressed resulting in a drift of 2 ml per 24-hour period.

Bio: Gergo Edes received his M.S. degree in mechanical engineering from the Slovak University of Technology, Bratislava, Slovakia in 2014, and completed a one-year visiting research scholarship at the University of Arizona in 2013 involving the development of MTJ magnetic sensor based implantable flow sensors for hydrocephalus patients. Since January 2015 he has been working towards a Ph.D. degree under the guidance of Professor Eniko Enikov at the Aerospace and Mechanical engineering faculty at University of Arizona.