Retrieval Optimization in Magnetic Resonance Fingerprinting

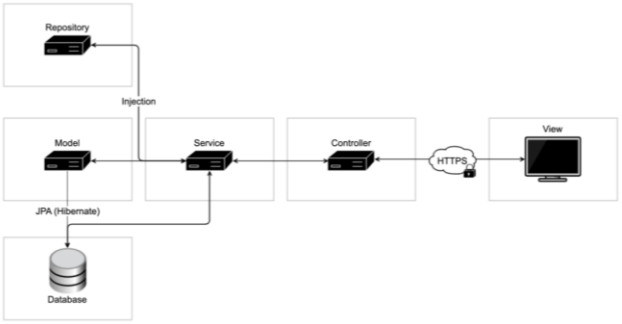

Figure 1: Architecture of *Dactyloquant (*Picture: M. Hürbin).

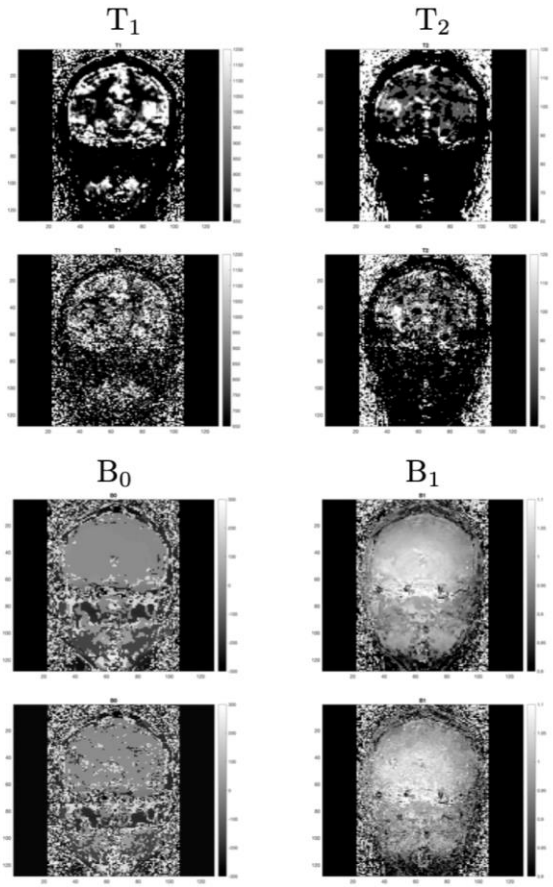

Figure 2: Proof of concept reconstruction of different MRI parameters (Relaxation times T1,T2, magnetic field homogeneity B0, and radiofrequency transmit field B1) using brute-force (top rows) and SB-LSH (Picture: M. Hürbin).

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Quantitative approaches in MRI are crucially needed to provide comparable metrics across patients and pathology types. Model-based approaches, such as MR Fingerprinting (MRF) proposed in 2013[1] have brought an original formalism where the complexity inherent to quantitative measurements with magnetic resonance is shifted towards a pattern-matching problem *in silico*. As such, a custom-built MRI dataset is matched to a large, pre-computed database to retrieve quantified properties of interest. The best match then yields the required information for a proper reconstruction of the image. Considering databases with over 250.000.000 entries, the time to find a best match becomes critical. Additionally, such large amounts of data require adequate processes to store and access data. This work introduces *Dactyloquant*, a software client treating the aforementioned matching pipeline as a nearest neighbor search problem as typically seen in multimedia retrieval. Dactyloquant uses and extends *Cottontail DB* – a specialized database for multimedia retrieval queries – for storage and data access. This newly developed system does not only enable scalability since it uses on-disk storage, but it also introduces modern index structures, such as Super-Bit Locality-Sensitive Hashing (SB-LSH)[2] or the Vector-Approximation+ File [3], that speed up the look up significantly and thus provide a valid alternative in current MRF data reconstruction research.

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(2) Ji, J. et al. Super-Bit Locality-Sensitive Hashing. Advances in Neural Information Processing Systems, 1:108–116 (2012).
(3) Ferhatosmanoglu, H. et al. High dimensional nearest neighbor searching. Information Systems, 31(6):512–540 (2006).